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MODAL REALISM WITH OVERLAP

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In this paper, I formulate, elucidate, and defend a version of *modal realism with overlap*, the view that objects are literally present at more than one possible world. The version that I defend has several interesting features: (i) it is committed to an ontological distinction between regions of spacetime and material objects; (ii) it is committed to *compositional pluralism*, which is the doctrine that there is more than one fundamental part-whole relation; and (iii) it is the modal analogue of *endurantism*, which is the doctrine that objects persist through time by being wholly present at each moment they are located.

I. Problems for Modal Realism with Overlap

Despite David Lewis's impressive arguments for modal realism, it is safe to say that it has won few adherents. Moreover, modal realism with overlap (henceforth: 'MRO')—the view that objects are literally present at more than one world—is probably the least popular position to occupy in modal metaphysics. Consequently, the possibility that a version of modal realism with overlap might be a serious contender has been virtually ignored.

However, we ought to examine MRO more carefully for the following reasons. First, one reason for rejecting modal realism is that it allegedly implies a counterpart-theoretic account of *de re* modality, according to which claims about the properties that an object could have had are made true by the existence of a counterpart of that object which has those properties. But modal realism *per se* is not committed to counterpart theory. One realist alternative to counterpart theory is modal realism with overlap.

Second, as Richard Miller has pointed out, philosophers tend to think of modal realism as if David Lewis were its sole defender, and this attitude encourages philosophers to think that the metaphysical commitments of David Lewis are the metaphysical commitments of every modal realist [Miller 2001]. Accordingly, it is worthwhile to see how far alternatives to Lewis's version of modal realism can be pushed.[1] A third and related reason for carefully examining MRO is that it is the realist view that is most hospitable to three dimensionalists, since, as I will argue, a properly formulated modal realism with overlap is the modal analogue of certain versions of three dimensionalism. An exploration of MRO might shed some light on the debate between three dimensionalists and four dimensionalists about persistence through time.

Here I present, argue for, and defend what I take to be the best version of MRO. The version of MRO that I advocate differs from the view discussed by David Lewis in his now classic *On the Plurality of Worlds* [Lewis 1986a: 198–209]. Some of the distinctive

[1] David Lewis discusses modal realism with overlap in [1986a: 198–209]. The only other lengthy discussion of modal realism with overlap that I am aware of is by Teller [2001].

features of the version of MRO defended here are (i) an explicit commitment to an ontological distinction between regions of spacetime and their material contents and (ii) a commitment to two distinct fundamental part-whole relations. Both (i) and (ii) demand elucidation; I attend to this task in section two. In the final section, I discuss an interesting implication that modal realism with overlap has for the metaphysics of material objects.

Let me make clear what I mean by 'modal realism'. Following Phillip Bricker, I take modal realism to be the conjunction of the following claims: possible worlds exist; worlds are qualitatively determinate individuals rather than incomplete objects, properties, propositions, or sets; and worlds have mereological structure [Bricker 2001: 28–89].

I make no attempt to argue for modal realism here. I simply assume that some form of modal realism is true. Accordingly, our question is this: given modal realism, is there some version of modal realism with overlap that is a defensible view? However, despite my simply assuming modal realism, my project has significance for other areas of modal metaphysics. For example, modal fictionalists tend to take as their candidate fiction Lewisian modal realism, but if some version of MRO is viable, then fictionalists should consider taking that to be the appropriate fiction. Likewise, Theodore Sider's actualist ersatz pluriverse account [2002] easily could be modified so as to accommodate something like MRO.[2]

As I see things, Lewis discusses two distinct versions of modal realism with overlap in *Plurality*, although he does not clearly distinguish these versions. Both of these versions face serious objections. The first version of MRO is either inconsistent with the intuitions that motivate it or flat-out internally inconsistent. The second version of MRO requires primitive modality. Both should be rejected.

The first version of MRO is the conjunction of theses (1)–(3). Let us call this version of MRO simply 'MRO1'.

(1) The standard modal realist account of possible worlds and analysis of *de dicto* modality in terms of them.
(2) The claim that some objects exist at more than one world, where this claim is analysed as follows: there is an object x and worlds *w1* and *w2* such that x is a part of *w1*, x is a part of *w2*, and *w1* is not identical to *w2*.
(3) 'Possibly Fa' is to be analysed as 'there is some world w such that a exists at w and a is F at w'.[3]

A few comments on (1) are in order. First, let us note that the standard modal realist account of possible worlds includes the following assumptions:

(4) The relation of part to whole is a two-place relation: x is a part of y *simpliciter*.
(5) The relation of spatiotemporal relatedness is a two-place relation: x is spatiotemporally related to y *simpliciter*.[4]

[2] On fictionalism, see Nolan [1997] and Rosen [1990].

[3] There is one class of predicates for which this analysis does not hold. This is the class of predicates that includes, e.g., 'x does not exist'. A sentence like 'possibly a does not exist' is not made true by the existence of a world such that a exists at that world and has the property of not existing at that world. Instead, the sentence is made true by there being a world such that a does not exist at that world.

[4] I say that two spacetime regions are spatiotemporally related just in case they are parts of some topologically connected spacetime region. Two occupants are spatiotemporally related just in case they occupy spatiotemporally related regions of spacetime.

(4) and (5) are important. The main attraction of modal realism is that it promises a reductive account of modality; the standard modal realist's account of possible worlds presupposes (4) and (5):

(6) *w* is a possible world if and only if (i) there are some *x*s such that each one of the *x*s is spatiotemporally related to every object that is one of the *x*s, (ii) none of the *x*s is spatiotemporally related to any object that is not one of the *x*s, and (iii) *w* is the fusion of the *x*s [Lewis 1986a: 69–81].

And using (6), the modal realist provides a reductive analysis of *de dicto* possibility and necessity: a proposition is possible iff it is true at some world; a proposition is necessary iff it is true at all worlds.

Lewis rejects MRO1. His reason for rejecting MRO1 is that MRO1 implies that every object has its intrinsic properties essentially. Consider some object *a* that is F but allegedly only contingently so. Given MRO, 'Possibly (∼F)*a*' is true if and only if there is a possible world *w* such that *a* is a part of *w* and *a* is not F at *w*. But, given the standard account of modal realism, the phrase '*a* is F at world *w*' implies that '*a* is F', whenever F is an intrinsic property; likewise, 'a is ∼F at *w*' implies 'a is ∼F'. This is because 'a is F at *w*' is analysable as '*a* is F' and 'a exists at *w*'. Accordingly, '*a* is F at the actual world' and '*a* is ∼F at world *w*' are inconsistent with each other. So *a* must have F essentially. So MRO1 implies that every object has its intrinsic properties essentially.[5]

Similar worries arise about the parthood relation. I have my hand as a part, but having my hand as a part is not one of my essential features; I could have existed and not had this hand as a part. There is a possible world according to which both my hand and I exist, but my hand is not a part of me. Given this formulation of MRO, there is a world that has as parts my hand and me, but I do not have my hand as a part at this world. But, given the assumption that parthood is a 2-place relation, I must have my hand as a part at that world (since I have my hand as a part *simpliciter* and that world has me as a part). So MRO1 implies *mereological essentialism*, which is the doctrine that an object has its parts as a matter of necessity.

These are strong objections. But perhaps the advocate of MRO1 could bite the bullet and hold that every object has its intrinsic properties and parts essentially. I suppose the advocate of MRO1 could make this move, but it undercuts the main motivation for embracing the claim that possible worlds literally overlap. The main motivation for MRO is the intuition that the truthmaker for claims such as 'It is possible that Al Gore won the 2000 U.S. presidential election' must include, in some intimate sense of 'include', the object that the claim is about. But this intuition is substantially undermined if the majority of the *de re* possibility claims we make about material objects are false.

So Lewis rejects overlap; specifically, Lewis rejects clause (2). But this is not the only response to this argument. Instead, the realist could rethink (1), and hence rethink (4), (5), or (6). Let us explore this strategy. One seemingly straightforward way around the objection is to *index* property-instantiation and parthood to worlds. According to this strategy, objects do not simply instantiate properties; to say that *x* is F is at best elliptical for saying that *x* is F at *w*, where the value of *w* is determined by the context of the utterance. Likewise, objects do not simply instantiate relations; instead, they instantiate relations

[5] This argument is extremely condensed. For the uncondensed version, see Lewis [1986a: 198–209].

relative to worlds. So, according to this response, the allegedly two-place relation, *x* is spatiotemporally separated by 2 units from *y*, is actually a three-place relation, *x* is spatiotemporally separated by 2 units from *y* at world *w*.

The cost of indexing *all* properties and relations to worlds is too high to pay. First, MRO1 + the strategy of indexing properties to worlds is inconsistent, since MRO1 implies assumptions (4) and (5) and the relativizing strategy rejects (4) and (5). So the advocate of MRO should drop (4) and (5) and instead accept:

(7) The relation of part to whole is a three-place relation: *x* is a part of *y* at *w*.
(8) The relation of spatiotemporal relatedness is a three-place relation: *x* is spatiotemporally related to *y* at *w*.

Let us call this theory MRO2.

Realists should reject MRO2, since it cannot provide a reductive account of modality. For the realist analysis of a possible world becomes:

(9) *w* is a possible world if and only if (i) there are some *x*s such that each one of the *x*s is spatiotemporally related ***at w*** to every object that is one of the *x*s, (ii) none of the *x*s is spatiotemporally related ***at w*** to any object that is not one of the *x*s, and (iii) w is the fusion ***at w*** of the *x*s.

If our goal is to provide an analysis of modality, then endorsing (9) is no better than saying that the *x*s belong to the same world if they are worldmates of each other.[6] *Part-at-world-w* and *instantiates-at-world-w* are the primitive parthood and instantiation relations according to MRO2. But these primitive relations are clearly modal relations, since they directly involve possible worlds. So going this route requires surrendering the main reason to be a modal realist, namely the desire for a reductive account of modality.[7]

So it looks like modal realism with overlap is in serious trouble. Either it is internally inconsistent or it is inconsistent with the main reason for believing it. Fortunately, a consistent and plausible version of modal realism with overlap can be formulated that still allows for a reductive account of modality. Let us now turn to the details.

II. Ontological and Compositional Pluralism

We will need to formulate a hybrid version of modal realism with overlap in order to get around the difficulties that faced MRO1 and MRO2. Our desiderata are that the view be consistent, avoid commitment to mereological essentialism, and still allow for a reductive account of modality. This hybrid view will recognize (at least) two fundamental ontological categories: the category of spacetime regions and the category of material occupants of spacetime regions. Moreover, and more controversially, the hybrid view will recognize two fundamentally different kinds of part-whole relations: a non-indexed part-whole relation that is restricted to the category of spacetime regions and a *spatiotemporally relativized*

[6] Phillip Bricker has pointed out to me that (9) is informative even though it cannot be an analysis of the notion of a possible world. In this respect, (9) is better than simply saying that objects belong to the same world if and only if they are worldmates. But it is useless as an analysis of modality.

[7] Of course, there are other reasons to endorse modal realism besides the hope for a reductive account of modality, e.g., its reductive account of propositions and properties.

part-whole relation that is restricted to the category of material occupants. In other words, the part-whole relation defined on the category of material objects is such that, for any region of spacetime *R*, it makes sense to ask of two objects *x* and *y* whether *x* is a part of *y* relative to *R*.

If there is exactly one fundamental parthood relation, and it is a two-place relation, then it seems that MRO is committed to mereological essentialism. And if there is exactly one fundamental parthood relation, and it is the three-place relation *x* is a part of *y* at *w*, then MRO cannot provide a reductive account of modality. One way to avoid this dilemma is to abandon the assumption there is exactly one relation of part to whole. I will return to this issue momentarily.

One of the fundamental projects of metaphysics is to provide principles telling us what ontological categories there are and what distinguishes the categories from one another. Another fundamental project of metaphysics is to provide the principles that tell us under what circumstances an element of an ontological category is *simple* or *complex*, i.e., under what circumstances it is appropriate to attribute part/whole structure to a particular entity. It is important to note that the generalized concept of part/whole structure does not apply only to material objects like tables and chairs, for each of the following attributions of part/whole structure makes perfect sense:

(1) The first measure is a part of the song.
(2) 12:30 PM is a part of the interval ranging from 12:00 PM to 1:00 PM.
(3) This part of space is curved.
(4) The third inning was the most boring part of the baseball game.
(5) The weakest part of his argument is where he confuses types and tokens.
(6) Part of what he did when he killed the butler was hit him with a candlestick.
(7) {a} is a proper part of {a,b}.

(1) ascribes part/whole structure to abstract types; (2) ascribes part/whole structure to intervals of time; (3) ascribes part/whole structure to regions of space; (4) ascribes part/whole structure to events; (5) ascribes part/whole structure to arguments; (6) ascribes part/whole structure to actions; and (7) ascribes part/whole structure to sets or classes. Each of these is perfectly intelligible; each of these might be true.[8]

However, we should not infer from the intelligibility of (1)–(7) that *compositional monism* is true. *Compositional monism* is the view that (i) there is exactly one fundamental part-whole relation and (ii) this relation applies to elements of every ontological category. According to the compositional monist, parthood is importantly similar in this respect to the relation of identity. Just as there is only one fundamental identity relation that applies to any entity regardless of what ontological category it belongs to, there is only one fundamental parthood relation. Accordingly, a congenial position for the compositional monist to hold is that the parthood relation is a formal logical (or ontological) relation, just as identity is.[9]

[8] Peter Simons stresses this point throughout [Simons 1987].

[9] This sort of position could be motivated by arguments that composition is strongly analogous to identity. On the analogies between composition and identity, see Lewis [1991: 81–7] and van Inwagen [1994].

The *mereologist*, i.e., the person who believes that the axioms of standard mereology adequately characterize *the* topic-neutral part-whole relation, is a compositional monist.[10] According to the mereologist, there is exactly one fundamental parthood relation, and one way of generating complex entities out of simple ones, namely mereological fusion. The compositional *pluralist* disagrees. According to the compositional pluralist, just as there is more than one fundamental, irreducible ontological category, there is more than one fundamental, irreducible parthood relation.[11] There is, of course, a plurality of forms of compositional pluralism. One way of being a compositional pluralist is to claim that each ontological category has its own parthood relation. According to this way of being a compositional pluralist, the relation of part to whole that obtains between, e.g., regions of space is not the same relation as the relation of part to whole that obtains between material objects. Moreover, according to this form of compositional pluralism, it makes no sense to say that there is a whole composed of objects from distinct ontological categories. So, for example, there is no object made out of my car and the region of space that it exactly occupies, contrary to the claims of the mereologist.[12] I claim that the defender of modal realism with overlap should be this sort of compositional pluralist. According to the kind of modal realism with overlap that has the most going for it, there are (at least) two ontological categories—the category of spacetime regions and the category of material occupants of spacetime regions—and (at least) two distinct part-whole relations: a part-whole relation defined on spacetime regions and a *spatiotemporally indexed* part-whole relation defined on material objects. Both relations are fundamental; neither is reducible to the other.

In this respect, a sensible modal realism with overlap resembles what I take to be one popular version of three dimensionalism. In many ways, the debate between the advocates of modal realism with overlap and modal realism with counterpart theory resembles the debate between three dimensionalists and four dimensionalists about persistence through

[10] On standard mereology and other interesting variations of it, see Simons [1987]. Simons is, of course, no compositional monist; Simons [1987] provides a powerful defence of compositional pluralism. One famous monist is, of course, David Lewis [1991: 75–82].

[11] One of the challenges facing compositional pluralists is to provide principles that determine when a relation is a fundamental parthood relation. In other words, the compositional pluralist must provide a way of filling in the following schema: *x* is a fundamental parthood relation defined on a class of entities *C* if and only if .... This strikes me as being a very difficult project. It is clear that there are necessary conditions on being a parthood relation. For example, no relation deserves to be called a parthood relation unless it is reflexive, transitive, and non-symmetrical. One could even argue that every parthood relation obeys the axioms of classical mereology, provided that the quantifiers in the axioms are restricted to the domain that the parthood relation is defined on. However, even these structural conditions are clearly not sufficient. (This question is clearly related to the question van Inwagen calls the *General Composition Question*. On this question, see van Inwagen [1990a: 38–51].)

[12] This form of compositional pluralism is in tension with the doctrine that there are states of affairs that are 'unmereologically composed' of objects and properties, where these entities belong to distinct ontological kinds. As I see things, there are three reasonable responses to this worry. The first response is to give up states of affairs. This is the response that I favour. The second response is to give up the claim that states of affairs are unmereologically composed of objects and properties, and instead merely say that, e.g., necessarily, the state of affairs that *a* is F exists if and only if *a* is F. The third response is to allow that there is a distinct kind of composition that can unite members of distinct ontological kinds, but still have some categorically restricted composition relations. On the 'unmereological composition' of states of affairs, see Armstrong [1986] and Lewis [1986b].

time. Roughly, three dimensionalism is the view that a persisting object is 'wholly present' at each instant that it exists. This view should be contrasted with four-dimensionalism, which is the view that a persisting object is not wholly present at each instant that it exists; instead, according to four-dimensionalism, an object persists by having a temporal part that is located at each instant that they exist.[13]

Modal realism with overlap is the modal analogue of three dimensionalism, since both views allow for one and the same object to be wholly present at distinct regions of space-time. Moreover, we can see how far this analogy extends if we examine the argument from temporary intrinsics, which is designed to refute three dimensionalism. This argument is, of course, perfectly parallel to the argument from accidental intrinsics used by Lewis against MRO.[14] Suppose that *Eternalism* is true. Roughly speaking, Eternalism is the doctrine that all times (and their contents) are ontologically on a par; past and future times exist in just the same sense as present times exist.[15] Suppose as well that a persisting object *o* is spherical at t1 and cubical at t2.[16] Here is a (far too brief) summary of the argument from temporary intrinsics. If three dimensionalism is true, then one and the same object is both spherical and cubical. But this is impossible. So three dimensionalism is not true.[17]

And of course, a similar worry arises about the parthood relation. It is this worry that I wish to concentrate on here. One might argue that three dimensionalism—given eternalism—is committed to *mereological constantism*, which is the temporal analogue of mereological essentialism. According to mereological constantism, if an object has a part at one time, it has that part at every time that the object is present. Suppose that compositional monism is true, and the fundamental part-whole relation is the non-temporally indexed relation *x is a part of y*.[18] Since this is a non-temporally indexed parthood relation and it is *the* parthood relation, the temporal relativizations on ascription of parts to an object simply drop off. If an object has a part at a time, it has that part *simpliciter*. And, accordingly, we have mereological constantism.

Given three dimensionalism, mereological constantism is as unacceptable as mereological essentialism; both are wildly counter-intuitive. We must reject one of the premises in the argument that leads to mereological constantism. There is a wide range of potential targets. But the most popular target is the assumption that the fundamental part-whole relation that applies to material objects is an atemporal part-whole relation. Instead, most three dimensionalists opt for the view that the fundamental part-whole relation

[13] Three dimensionalism is sometimes called *endurantism*; four dimensionalism is sometimes called *perdurantism*. For defences of three dimensionalism, see Simons [1987] and van Inwagen [1990b]. For arguments for four dimensionalism, see Heller [1990]; Lewis [1986b: 202–5]; Sider [2001].

[14] No surprise here, since Lewis is the author of both arguments [1986a: 202–5]. For responses, see Haslanger [1989] and Teller [2001].

[15] For an interesting discussion about eternalism see chapter two of Sider [2001] and Markosian [1994].

[16] I assume here that shapes are intrinsic properties.

[17] I have little to say here about the argument from temporary intrinsics. However, I will assume without argument that the strategy of indexing property instantiation to times or spacetime regions is an acceptable response to the problem. On this strategy, see Haslanger [1989]. The metaphysics of properties is more complicated given MRO, since we cannot straightforwardly identify properties with sets of their instances. Andrew Egan recommends that the advocate of MRO take properties to be *functions* from worlds to extensions [2004].

[18] Sometimes this relation is called an *atemporal* part-whole relation.

that applies to material objects is a temporally indexed part-whole relation: *x* is a part of *y* at *t*.[19]

Must the three dimensionalist/eternalist who takes this route also be a compositional pluralist? There is a powerful reason to say she must. For the three dimensionalist believes in intervals of times.[20] And it is undeniable that part-whole structure applies to these entities. However, what is deniable—and what ought to be denied—is that the fundamental part-whole relation that is defined on temporal intervals is the relation *x* is a part of *y* at *t*. It seems clear that the fundamental parthood relation defined on temporal intervals is a non-temporally indexed parthood relation, but in case an argument for this is required, consider the following. Suppose that the fundamental parthood relation defined on temporal intervals is *x* is a part of *y* at *t*. At what time is 12:30 a part of the interval beginning at 12:00 and ending at 1:00? Given the principle that an object *x* is part of another object *y* at time *t* only if *x* and *y* are both wholly present at *t*, there is no time at which 12:30 could be a part of the interval (12:00, 1:00). This is because (i) this interval is not wholly present at 12:30 and (ii) 12:30 is only wholly present at itself. So the advocate of three dimensionalism and Eternalism should not say that the parthood relation defined on times is the temporally indexed parthood relation *x* is a part of *y* at *t*.

So the three dimensionalist should believe that the fundamental parthood relation defined on intervals of times is the non-temporally indexed relation *x is a part of y*. However, in order to avoid mereological constantism, the three dimensionalist should believe that the fundamental parthood relation defined on material objects is the temporally relativized relation *x is a part of y at t*. It should be clear that these two parthood relations are not identical, since their *adicity* differs; *x is a part of y* is a two-place relation, whereas *x is a part of y at t* is a three-place relation. So the three dimensionalist should be a compositional pluralist.[21]

Accordingly, if the advocate of modal realism with overlap must believe in compositional pluralism, then she is in good company.[22] There is still a difference between taking the parthood relation defined on material objects to be indexed to a time and taking it to be indexed to a spacetime region, as the advocate of MRO should. However, I believe that there is a powerful reason for the three dimensionalist to take the fundamental parthood relation defined on material objects to be spatiotemporally indexed as well. That is, instead of taking the fundamental parthood relation defined on material objects to be *x is a part of y at t*, the three dimensionalist should take it to be *x is a part of y at R*, where *R* is a region of spacetime.[23]

[19] Another popular target is eternalism. Many philosophers instead endorse *presentism*, which is the doctrine that the only things that exist are those things that presently exist. On presentism, see Hinchliff [1996] and Markosian [forthcoming].

[20] Sider presents powerful reasons for the three-dimensionalist to be a substantivalist about spacetime [2001: 110–19].

[21] The anonymous referee suggested that one could respond to this argument by holding that the parthood relation is *multigrade*. I grant that there is a multigrade *parthood* relation, since it is the disjunction of each *categorically defined* parthood relation, but deny that it is fundamental. I am unsure how to settle this issue.

[22] Provided, of course, that three dimensionalists are good company. At the very least, the defender of MRO has company!

[23] Hud Hudson presents a more developed account of a view that indexes the part-whole relation to regions [2001: 62–70].

The main reason the three dimensionalist should take the fundamental parthood relation defined on material objects to be indexed to spacetime regions and not to times is special relativity.[24] Given special relativity, strictly speaking, there are no such things as times, or at least, there are no things that perfectly match our concept of what it is to be a time.[25] Instead, there are equivalence classes of regions of spacetime that may be thought of as times *according to an inertial frame of reference*. Since the three-place relation *x is simultaneous with y relative to frame F* is well-defined, we can say that a time relative to *F* is a maximal class of spacetime points pair-wise simultaneous to each other relative to *F*. Of course, the three dimensionalist could say that the fundamental parthood relation defined on material objects is indexed both to a time and a frame of reference. But these times (and frames of references) are hardly fundamental entities—they are paradigmatic instances of logical constructions—and so it would be strange to index a fundamental relation to entities that are clearly not fundamental constituents of the world. A far more natural move for the three dimensionalist to make is to take the fundamental parthood relation defined on material objects to be spatiotemporally indexed and then analyse the parthood relation *x* is a part of *y* at *t* at frame *F* in terms of it.[26]

Fortunately, we can do this. We begin by taking our primitive parthood relation to be *x* is a part of *y* at *R*, where *R* is a region of spacetime. If we wish, we can restrict the candidate regions to those that are maximally continuous three-dimensional slices of spacetime, i.e., hyper-planes.[27] Three dimensional slices of spacetime are the sorts of things that three dimensional objects can be wholly present at, allowing us to adopt the following axiom: *x* is a part of *y* at *R* only if both *x* and *y* are wholly present at *R*. We next introduce the notion of being a time at a reference frame: times at reference frames are fusions of spacetime points such that each point is simultaneous with the others at that reference frame. Finally, we introduce a defined time and frame indexed parthood relation: *x* is a part of *y* at *t* at *F* if and only if there is an *R* such that *x* is a part of *y* at *R* and *R* is *t* at *F*.[28]

Note that this sort of definition will also be available for use in spacetimes in which a two-place notion of absolute simultaneity is well defined. As above, the fundamental spatiotemporal entities are spacetime points. However, in these spacetimes we can identify

[24] Perhaps it is not the only reason. Recently, Hud Hudson has argued that indexing the part-whole relation to regions of spacetime also solves the pressing problem of the many [2001: 45–71]. Additionally, Theodore Sider has suggested that the three dimensionalist should index parthood to regions of spacetime in worlds in which time travel into the past is possible [2001: 104–5].

[25] I am heavily indebted to Theodore Sider for what follows here.

[26] See Sider [2001: 84–5]. Phillip Bricker has pointed out to me that we can also say that an entity is a time just in case it is a three dimensional spacelike hyper-plane. Let us call the entities that I call times in the body of the text '1-times' and the three dimensional timelike hyper-planes '2-times'. On this proposal, 2-times simply are certain spatiotemporal regions, specifically, those regions such that are fusions of the elements of some 1-time. Note that on this proposal, indexing parthood to a time simply is indexing parthood to a region, since every time is a region of spacetime.

[27] Phillip Bricker has informed me that in the context of general relativity, there are no hyper-planes of simultaneity. Worse, we have no guarantee that there are three-dimensional spacelike hyper-planes either. Accordingly, in the context of general relativity, the regions for which parthood is indexed must be more local. (Note that these regions will be *spatiotemporal* regions, so there is no pressure to postulate a second fundamental parthood relation defined on material objects.)

[28] This procedure is a modification of a proposal made by Theodore Sider [2001: 84–5]. According to Sider's proposal, we begin by taking the notion *x overlaps y at spacetime point R*

times with maximal fusions of simultaneous spacetimes points, which are simply hyperplanes of simultaneity.

So the three dimensionalist has a strong reason to take the fundamental parthood relation defined on material objects to be indexed to spacetime regions instead of times. But special relativity is only contingently true. There are possible worlds in which a relation of absolute simultaneity is well defined. So the reason for taking the parthood relation that is defined on material objects to be indexed to spacetime regions is contingent. This leads us naturally to a rather interesting question: could the parthood relation defined on material objects have been a different relation than the one that it actually is? Could, for example, the parthood relation defined on material objects be a non-indexed parthood relation *x* is a part of *y* (as the four dimensionalist thinks), or a *temporally* indexed parthood relation *x* is a part of *y* at *t*, or a *spatially and temporally* indexed parthood relation *x* is a part of *y* at *S* at *t*?[29]

This question is even more pressing for the three dimensionalist who is also a modal realist.[30] For the modal realist, if it is possible that some other fundamental parthood relation be defined on material objects, then there *is* some other fundamental parthood relation defined on material objects. In some worlds, the fundamental parthood relation is R, while in other worlds, it is R$, and so on. But this commits the three dimensionalist modal realist to compositional pluralism *within the same ontological category*. And this sort of pluralism is much less plausible than a compositional pluralism that says that each ontological category has a unique parthood relation that is defined on its elements. For one thing, this sort of compositional pluralism seems to require treating the various *parthood* relations as if they were perfectly natural relations like spacetime interval and (perhaps) causation. In other words, this brand of compositional pluralism requires taking the various parthood relations to be *material* relations, when they seem to be *formal* or *structural* relations. And this seems to me to be a mistake.

Perhaps the best course for the three dimensionalist modal realist to take is to insist that (i) the fundamental parthood relation defined on material objects is the same at every world and (ii) the best candidate for being the parthood relation that is necessarily defined on material objects is a spatiotemporally indexed parthood relation. This is the course that I will follow.[31]

Let us take stock of where we are so far. I have argued that the three dimensionalist should believe that enduring objects are wholly present at multiple regions of spacetime;

[28] *continued*
as our mereological primitive. We then introduce a time-frame indexed notion of parthood as follows:

> *x overlaps y at t at F* = df. there is a spacetime point *p* in *t* at *F* such that *x* overlaps *y* at *p*.
> *x is a part of y at t at reference frame F* = df. Everything that overlaps *x* at *t* at *F* overlaps *y* at *t* at *F*.

I prefer this account of part at *t* at F to Sider's account because it seems clear that ordinary objects cannot be wholly present at spacetime *points*.

[29] Note that the reasons for indexing parthood to regions of spacetime discussed in note 24 are also contingently true.

[30] At one point in his career, Lewis entertained the possibility that there are worlds at which objects persist by enduring [1986c: x]. What is the fundamental parthood relation at those worlds?

[31] However, this does seem to require saying that, as a matter of necessity, spacetime is ontologically prior to space and time. And this might seem objectionable. Accordingly, let us note that MRO

moreover, according to three dimensionalism, some of these objects have different parts or properties at different regions. The target version of modal realism with overlap agrees with the three dimensionalist on both of these matters.

I now want to use these concepts to formulate a new version of modal realism with overlap. Accordingly, it is important to note that the primitive concept of being wholly present at a region of spacetime is *not* a modal primitive; nor are the concepts of having a part at a region or a property at a region of spacetime modally loaded primitives. We can see this if we simply consider that a three dimensionalist could consistently be an anti-realist about modality. Consequently, it is fair game for the advocate of modal realism with overlap to use these concepts in his account of what it is for an object to exist at a world or have a property at a world. Doing so will not require primitive modality.

III. The Account of Possible Worlds and Existence at a World

We are now in a position to state the version of MRO that I favour:

(1) *w* is a possible world if and only if (i) *w* is a region of spacetime, (ii) every part of *w* is spatiotemporally related to every other part of *w*, (iii) no part of *w* is spatiotemporally related to anything that is not a part of *w*.

This conception of possible worlds is subtly different from Lewis's account. According to the account of possible worlds embodied in (1), possible worlds are maximally spatiotemporally related regions of spacetime, whereas according to David Lewis [1986a: 73], a possible world is the 'totality of things it contains'. Given (1), worlds are containers in the same sense that regions of spacetime are containers, since worlds are regions of spacetime. However, there is an obvious sense in which an object can be contained by a region of spacetime, i.e., be wholly present at that region, without being a *part* of that region. Likewise, an object can be contained by a world, i.e., *exist at* that world, without being a part of that world. The notion of existing at a world can be characterised as follows:

(2) An object *x exists at a world w* iff there is some region *R* such that (i) *x* is wholly present at *R* and (ii) *R* is a part of *w*; a region *R* exists at a world iff it is a part of that world.

Although this account of what it is for an object to exist at a world is different from the account presented by Lewis, applying the name 'modal realism with overlap' to this account is still justified, since some worlds have overlapping contents. That is, according to this version of MRO, there are worlds *w1* and *w2* such that there is an object that literally exists at both worlds, just as, according to the three dimensionalist, there are spacetime

[31] *continued*
could be formulated in a way that allowed the fundamental part-whole relation defined on material objects to differ from world to world. So even if one thinks that what follows is wrongheaded, one need not give up MRO. It should be clear how to reformulate the view to take into account the proposition that the fundamental parthood relation defined on material objects is not constant across worlds. (I also note that on the current proposal, it is necessarily true that every material object occupies a region of spacetime. However, I do not believe that this is problematic.)

regions *R1* and *R2* in the actual world such that there is an object that literally is wholly present at both regions.

In addition to wanting an account of existing at a world, we also want accounts of what it is for an object to have a part at a world and a property at a world. Parthood is reasonably straightforward:

(3) *x* is part of *y* at *w* iff there is some *R* such that *x* is part of *y* at *R* and *R* is a part of *w*.

The account of property instantiation is a little more complicated. There are two ways that an object might have a property relative to a world. First, the object might just plain have the property and be wholly present at some region that is part of the world. So, for example, every object is just plain self-identical. Objects are not self-identical relative to regions of spacetime, even though some self-identical objects occupy regions of spacetime. Some of the essential properties of objects are had in this fashion.[32] Second, the object might have the property *relative* to some region that is part of the world. This mirrors what the three dimensionalist will probably want to say about how objects have properties relative to times: an object might just plain have the property and be located at a time or the object might *instantiate at that time* the property.

We will want these distinctions to be incorporated in our accounts of *de dicto* and *de re* modality. We first formulate the MRO account of *de dicto* possibility:

(4) Possibly $(\exists x_1 \ldots x_n)Fx_1 \ldots x_n$ iff there is a world *w* such that there are entities $y_1 \ldots y_n$ such that each of $y_1 \ldots y_n$ exists at *w* and Fness applies to $<y_1,\ldots,y_n>$ at *w*.

(5) Possibly $(\forall x_1 \ldots x_n)Fx_1 \ldots x_n$ iff there is a world *w* such that for all entities $y_1 \ldots y_n$ that exist at *w*, Fness applies to $<y_1, \ldots,y_n>$ at *w*.

The concept of *de dicto* necessity is analysed in the familiar way. *De re* modality is trickier. Let us begin by considering the following account:

(6) Possibly $Fa_1 \ldots a_n$ iff there is some world *w* such that each of $a_1 \ldots a_n$ exists at *w* and Fness applies to $<a_1,\ldots,a_n>$ at *w*.

I am inclined to accept (6) as it stands. However, I anticipate that some philosophers will be dissatisfied with (6). We seem to ascribe *de re* modal properties to regions of spacetime as well as to occupants. Accordingly, we should see what (6) says about the *de re* modal properties of regions. (6) implies that that every spacetime region has all of its properties essentially, since every region exists at exactly one world. For example, consider two regions of spacetime *R1* and *R2* such that (i) they have the same metrical properties and (2) they are both parts of world *a*. Suppose that an object *O* occupies *R1*. Since *O* can move, it seems that *O* could have occupied *R2* instead. But, given (6), it is possible that *O* occupies *R2* only if there is some world *w* such that *R2* exists at *w* and *O* exactly occupies *R2* at *w*. But there is no such world; the only world at which *R2* exists is *a*. So, strictly speaking, given (6) it is not possible that *O* occupy *R2*.[33]

[32] Some but perhaps not all essential properties are had absolutely. Consider the disjunction of all possible shape properties that a given object can have. It seems that the object has this disjunction essentially, but has it relative to every region it occupies. I owe this observation to the anonymous referee.

[33] This version of MRO is not the only view committed to an extreme form of essentialism about spacetime points. Jeremy Butterfield [1989] argues that the best way to solve the 'hole' problem is to accept that every spacetime point (and region) exists at exactly one possible world.

I am not persuaded that this is a fatal defect of (6). First, it is not clear to me that we have strong intuitions about the *de re* modal properties of regions of spacetime. For if we do have strong intuitions about them, then we must have strong intuitions that regions of spacetime exist. And this does not seem correct. It seems to me that any apparent intuitions that we have about the *de re* modal properties of regions are really intuitions about the positions objects could have had *relative to one another*. Second, we *can* account for how material objects could have had different positions relative to one another, even if we must say somewhat strange things about their possible absolute positions in spacetime. Finally, let us note that we cannot avoid this problem by allowing worlds to overlap with respect to regions as well as occupants. For doing this would force us back into accepting MRO2, which I argued was an unacceptable theory of modality.

However, it is worthwhile to pursue alternatives to (6), in case (6) is unacceptable. Let us first note if a region has a property contingently, then that which makes this the case cannot be the region itself. Fortunately, there is a familiar strategy available to us: although literal identity across worlds accounts for the *de re* modal properties of material objects, the *de re* modal properties of regions of spacetime are determined by *counterparts* of those regions. David Lewis writes:

> Suppose two worlds are exactly alike up to a certain time, and diverge thereafter. I explain it thus. There is an initial segment of the other, which are perfect duplicates. They are maximal such segments: they are not respectively included in two larger initial segments which are also duplicates. There is a correspondence between the parts of these two segments under which the corresponding parts also are duplicates; and under which the corresponding parts are related spatiotemporally, and as whole to part. Therefore the corresponding parts are excellent counterparts. They are so whether you take a counterpart relation that stresses similarity of intrinsic character, or one that stresses extrinsic match of origins, or even one that stresses historical role. ... Temporal cross-sections of the worlds, for instance, are excellent counterparts: there are counterpart centuries, or weeks, or seconds. Likewise there are counterpart places: galaxies, planets, towns. So things that are part of two worlds may be simultaneous or not, they may be in the same or different towns, they may be near or far from one another, in very natural counterpart-theoretic senses. But these are not genuine spatiotemporal relations across worlds. The only transworld relations involved are internal relations of similarity; not indeed between the very individuals that are quasi-simultaneous (or whatever) but between larger duplicate parts of the two worlds wherein those individuals are situated.
>
> [Lewis 1986a: 70–1]

We are now in a position to formulate a second MRO account of de re modality. Let us reserve $a_1 \ldots a_n$ as dummy names for material objects and $r_1 \ldots r_n$ as dummy names for regions of spacetime. We now formulate the following account:

(7) Possibly, $\mathrm{Fa}_1 \ldots \mathrm{a}_n, r_1 \ldots r_n$ iff there is some world w such that (i) each of $a_1 \ldots a_n$ exists at w, (ii) each of $r_1 \ldots r_n$ has a counterpart $c_1 \ldots c_n$ that exists at w, and (iii) Fness applies to $<\mathrm{a}_1 \ldots a_n, c_1 \ldots c_n>$ at w.

We have now seen that we are able to characterize *de dicto* and *de re* possibility without invoking primitive modality. Admittedly, the version of MRO that accepts (7) does treat

de re modal claims about regions differently from how it treats *de re* modal claims about objects. But this difference in treatment is justified by the fact that the entities belong to radically different ontological categories, and so the difference is not an arbitrary difference, and by the fact that we do not have strong intuitions about the *de re* modal properties of regions, whereas our intuitions about the *de re* modal properties of objects are very strong.[34]

There is also a third strategy available. We could accept (6), and hence essentialism about spatiotemporal regions, but treat (7) as an account of when certain *de re* modal statements about regions are *acceptable*. Talk about the *de re* properties of regions can be useful, even if it is literally false, provided that it provides a way of characterizing the possible relative positions of objects to each other. Since talk about the possible occupation of regions does have this feature, counterpart theory can be used to provide a criterion of acceptability. This third strategy is perhaps the most preferable, but I need not adjudicate this issue here.

IV. MRO and Coincident Objects

The account of modal realism with overlap has philosophical consequences not just for the metaphysics of modality but also for the metaphysics of ordinary objects. Specifically, MRO has the philosophical resources to solve one longstanding puzzle in the metaphysics of material objects: the puzzle of coincident objects.

Consider the following instance of this puzzle. A statue, which we will call 'Stan', is created when his maker fuses together two pieces of clay; accordingly, at the same moment, a lump of clay, which we will call 'Larry' is created. Later the artist tires of the statue and throws it into an Atomizing Waste Eliminator, which instantly reduces the statue to its constituent atoms and then scatters them.

Stan cannot be identical to Larry. For Stan has *de re* modal properties that Larry does not have. For example, Stan has the *de re* modal property *being such that one cannot survive squashing*, whereas Larry lacks this property. So, by Leibniz's Law, Stan is not identical to Larry.

Stan must be identical to Larry. For Stan and Larry share all of the same parts at every time at which they exist. And no two objects can be made of the same parts. So, by mereological extensionality, Stan is identical to Larry.

We have a puzzle here. Both Leibniz's Law and mereological extensionality are highly intuitive metaphysical principles. But it seems though we must give one up. Interestingly, neither the advocate of modal realism with overlap nor the advocate of modal realism with counterpart theory needs to give up either principle. The advocate of modal realism with counterpart theory will hold fast to a straightforward interpretation of mereological extensionality but will argue that a proper analysis of *de re* modal claims reveals that we are not required to give up Leibniz's Law [Lewis 1986a: 248–63; Lewis 1971]. Conversely, the advocate of modal realism with overlap will hold fast to a straightforward interpretation of

[34] Butterfield also endorses counterpart theory for regions of spacetime [1989: 22–8].

de re predication but will argue that a proper formulation of mereological extensionality reveals that we are not required to give up mereological extensionality.

What is the proper formulation of mereological extensionality in the context of modal realism with overlap? Given that the advocate of modal realism with overlap holds that the primitive part-whole relation defined on material objects is *x is a part of y at R*, there are two obvious choices. The first is:

(ME1) For all x and y, if there is some R such that for any z, z is a part of x at R if and only if z is a part of y at R, then $x = y$.

But ME1 is not a good way to formulate the intuition driving mereological extensionality, for there can be objects that satisfy the antecedent of ME1 while nevertheless differing in a very clear sense with respect to their constituents. A far more reasonable principle is:

(ME2) For all x and y, if for any R and z, z is part of x at R if and only if z is a part of y at R, then $x = y$.

But clearly the case of Stan and Larry does not force us to abandon ME2, at least not if MRO is the correct account of *de re* modality. Since Stan and Larry differ with respect to their modal properties, given MRO, they differ with respect to what regions in logical space they occupy. But since they differ with respect to what regions they occupy, they must also differ with respect to which parts-relative-to-regions they have. But then they do not satisfy the antecedent of ME2, and hence do not form a counter-example to the principle.

Moreover, according to MRO, facts about *de re* modality are analytically posterior to facts about occupation and parthood at regions. So the advocate of MRO can even give an *explanation* for how the statue and the lump differ in their *de re* modal properties: they differ with respect to what regions of spacetime they occupy.[35] Admittedly, the advocate of MRO cannot give an explanation for why these two objects occupy different regions of spacetime. But explanations have to come to an end somewhere, and facts about occupation and parthood are perfectly respectable candidates for being the facts at which explanation ends.

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[35] This strategy is a natural extension of the strategy discussed in Wasserman [2002].

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