

# Mereological Indeterminacy: Metaphysical But Not Fundamental

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What is the nature of indeterminacy concerning the composition of ordinary objects? While orthodoxy sees all mereological indeterminacy as having its source in how we represent the world, there is increasing interest in the position that some mereological indeterminacy has its source in how the world is, independently of how we represent it—that is, the position that some mereological indeterminacy is metaphysical. Those attracted to metaphysical indeterminacy typically construe it as fundamental, either in the sense that facts about such indeterminacy are not grounded in any more basic, indeterminacy-free facts, or in the sense that the operator ‘indeterminately’ is perfectly natural, that it carves nature at the joints. This view incurs significant costs. Many judge the picture of fundamental metaphysical indeterminacy, often conceptualized in terms of multiple actualities, “crazy metaphysics.” Furthermore, fundamental metaphysical indeterminacy concerning composition raises the problem of indeterminate coincidence. I claim that there is an alternative to the fundamental view, which avoids these costs. I develop a picture of ordinary mereological indeterminacy, according to which the indeterminacy is metaphysical, in virtue of being representation-independent, but not fundamental; it is derivative metaphysical indeterminacy. The approach rests on an unorthodox quasi-hylomorphic ontology of ordinary objects.

## 1 Introduction

Suppose that mountain *M* is a massive collection of rocks deposited in layers. As a result of melting glacial ice, *M* gradually sheds rock mass; some rocks in the mountain’s surface layer slowly become loose and slide off. In this process, several surfaces become equally good candidates to be the boundary of the mountain. A surface including a particular loose rock, *r*, is an equally good candidate to mark the boundary of the mountain as a surface excluding *r*. As a consequence, the rock attains a questionable status: it is indeterminate whether *M* has *r* as a part. *M*’s mereological boundary is indeterminate.

This mereological indeterminacy claim has different readings, the *de dicto* and the *de re* reading. The two readings may be specified informally by using the colon to indicate the scope of the operator ‘It is indeterminate whether’:

*De dicto*

It is indeterminate whether: M has *r* as a part.

*De re*

M and the property of having *r* as a part are such that it is indeterminate whether: this object instantiates this property.

The difference is that on the *de dicto* reading it is indeterminate whether a certain description of the world is true, whereas on the *de re* reading it is indeterminate *of* a particular object and a particular property, whether the latter applies to the former.<sup>1</sup> Adopting a popular *façon de parler*, I shall say that if the *de re* reading of our claim of mereological indeterminacy is true, then M is a vague, or fuzzy, object. Mereological indeterminacy *de re* is naturally viewed as an instance of *metaphysical* indeterminacy, in the sense of being independent of conceptual, linguistic or epistemic representation.

The main question of this essay is whether such *de re* indeterminacy claims about ordinary objects' parts might be true—whether ordinary objects might be mereologically vague. To emphasize, the question is not whether any object could be indeterminate in any respect. The question specifically concerns the status of intuitive mereological indeterminacy claims about ordinary objects—that is, about objects falling under ordinary sortal concepts, such as the concept of a mountain.<sup>2</sup>

When philosophers contemplate the status of ordinary mereological indeterminacy, they typically juxtapose the following two positions:

- (I) All ordinary mereological indeterminacy is merely *de dicto* and has its source in how we represent the world.
- (II) Some ordinary mereological indeterminacy is *de re* and has its source in how the world is, independently of how we represent it.

According to the standard version of (I), mereological indeterminacy is linguistic in nature, arising from imprecision in how we refer to ordinary objects. The dominant brand of linguistic theory of indeterminacy is supervaluationism. In the case at hand, the supervaluationist recognizes a cluster of massively overlapping aggregates of particles with different precise decompositions (at a given time), such that each of these aggregates is a candidate referent for the name 'M'. Mereological indeterminacy of M is then analysed by supervaluating over these candidates. It is indeterminate whether: M has *r* as a part, since it is true of some admissible precisification of 'M' that it has *r* as a part, but not true of all admissible precisifications of 'M'. The standard supervaluationist thus accepts the *de dicto* reading of our indeterminacy claim

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<sup>1</sup> See Sainsbury 1989 and Williamson 2003 for the characterization of claims of indeterminacy *de re* as having the form: for some some object *x* and some property  $\varphi$ , it is indeterminate whether *x* instantiates  $\varphi$ .

<sup>2</sup> Some find the popular talk of vague objects dubious, on the grounds that an object is only ever vague, or indeterminate, in a certain respect. See, for example, Hawley 2002 and Williamson 2003. I share these doubts and emphasize that talk of vague objects will here be understood merely as loose and vivid talk. The serious notion in the background is that of indeterminacy *de re*.

about M. But she rejects the *de re* reading, because it is not the case of M that it is indeterminate whether it has *r* as a part, as each candidate referent has a clear-cut decomposition. There are no vague mountains in this world.<sup>3</sup>

This view is problematic. But I shall not attack it or any other version of position (I) here.<sup>4</sup> I mention (I) only to set the stage for position (II), which will be the subject of the following discussion. As an instance of (II), ordinary mereological indeterminacy of mountains might be taken to be *de re*. Instead of viewing the name ‘M’ in our example as referring imprecisely to multiple, precise objects, one might view the name as referring precisely to a unique, vague object. In §2, I will sketch the standard version of mereological indeterminacy *de re* and subject it to criticism. According to this version, mereological indeterminacy is metaphysical in nature, and it is fundamental. As my aim is primarily constructive, the purpose of this section is not to refute the account. The point is rather to highlight worries that give sufficient reason to scout for alternatives. In §3, I shall develop a novel version of mereological indeterminacy *de re* and show that it avoids the problems for the standard version considered in §2. According to this account, ordinary mereological indeterminacy is metaphysical, in virtue of being representation-independent, but it is not fundamental.

## 2 Fundamental Indeterminacy *De Re*

Indeterminacy *de re* of mereological boundaries of ordinary objects is naturally viewed as an instance, possibly one of many instances, of *metaphysical* indeterminacy, or of indeterminacy in the world, in the sense of being independent of conceptual, linguistic or epistemic representation. If there are facts of indeterminacy *de re* about ordinary objects, then these objects really are indeterminate, independently of how we represent them. Of course, this characterisation of indeterminacy *de re* as metaphysical only says something about what the indeterminacy is not, namely, a consequence of an imprecise representation. A positive account of its nature is a different matter.

So what is the nature of mereological indeterminacy *de re*?<sup>5</sup> The standard view is to construe this indeterminacy, along with metaphysical indeterminacy in general, as *fundamental*, either in the sense that facts about such indeterminacy are not grounded in any more basic, indeterminacy-free facts, or in the sense that the operator ‘it is indeterminate whether’ is perfectly natural, that it “carves nature at the joints”.<sup>6</sup> Friends of this view emphasize that while metaphysical indeterminacy cannot be analysed reductively, the notion can still be elucidated. It is indeterminate of mountain M whether: it has *r* as a part. This could be made intelligible by saying

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<sup>3</sup> See Lewis 1993.

<sup>4</sup> For criticism of the supervaluationist account of mereological indeterminacy in the context of a discussion of the problem of the many, see Sattig *forthcoming a*.

<sup>5</sup> For constructive discussion of metaphysical indeterminacy, see, *inter alia*, Akiba 2000, 2004, Barnes 2010, Barnes and Williams 2009, 2011, Morreau 2002, Parsons 2000, Rosen and Smith 2004, Skow 2010, Smith 2005, Williams 2008, and Williamson 2003.

<sup>6</sup> See, for example, Barnes and Williams 2011: 106.

that reality itself has different precisifications, all of which are perfectly precise, including one in which M has  $r$  as a part and one in which M lacks  $r$  as a part. One way of developing this idea is to view metaphysical indeterminacy as a kind of modality, which concerns worlds that are precisificationally possible—in other words, which concerns multiple actualities.<sup>7</sup> In this framework, mereological indeterminacy may be explicated by supervaluating over the varying mereological profiles of a given object in different actual worlds—instead of supervaluating over the mereological profiles of different, overlapping objects, as standard supervaluationism has it (see §1). It is indeterminate of M whether: it has  $r$  as a part iff there is a precisificationally possible world, an actuality, in which M has  $r$  as a part, and another precisificationally possible world, another actuality, in which M lacks  $r$  as a part.

The view of ordinary objects as having metaphysically indeterminate properties has been greeted with much resistance. Many, including Michael Dummett (1975), have found it unintelligible that there should be metaphysical indeterminacy. However, progress has been made on this front. For defenders of metaphysical indeterminacy have offered ways of rendering such indeterminacy intelligible, as the modal approach mentioned above illustrates. If you understand the idea that an object can be at home in different precisificationally possible worlds, and that it can vary in its mereological profile across these worlds, then you understand mereological indeterminacy *de re*.

Even if intelligibly glossed as arising from multiple precisifications of reality, many philosophers still refuse to admit fundamental metaphysical indeterminacy. And they may not base their attitude on arguments, because their real ground is the simple intuition that metaphysical indeterminacy, conceptualized as involving multiple actualities, is unbearably radical—for short, that it's crazy. This is a respectable attitude, comparable to Goodman's and Quine's motive for rejecting abstract entities: "Fundamentally this refusal is based on a philosophical intuition that cannot be justified by an appeal to anything more ultimate" (Goodman and Quine 1947: 174).

More can be said, though. An objection to mereological indeterminacy *de re* that takes the form of an argument is a recent attack by Brian Weatherson.<sup>8</sup> Consider again our mountain M. To start the argument, assume for *reductio* that it is indeterminate of M whether rock  $r$  is a part of it. The second premise of the argument is that there is an object, M-minus, that determinately has all and only the parts of M that do not overlap with  $r$ ; it is determinate of M-minus that: for all  $x$ ,  $x$  is a part of it iff  $x$  is a part of M and  $x$  does not overlap with  $r$ . Intuitively, there is this object, rigidly designated by the name 'M-minus' across different precisificationally

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<sup>7</sup> See, e.g., Barnes and Williams 2011.

<sup>8</sup> The original argument appears in Weatherson 2003: §4. In unpublished work, Weatherson has presented a second version of the argument that is meant to avoid a weakness in the first version, pointed out in Barnes and Williams 2009. The argument to be presented here is more or less Weatherson's second argument. For reasons of space, I shall be unable to address differences among versions and the interesting debate behind them. My aim is to sketch an account of vague ordinary objects that withstands the Weatherson attack in its most severe form—that is, even under the assumption that the Barnes-Williams-bug is fixable.

possible worlds, which is the mountain, M, without that particular rock. Note that this remainder of the mountain may itself have indeterminate parts.

Now let us say that an object *o* coincides with an object *o\** at a time *t* just in case *o* and *o\** occupy the same place at *t*. (Henceforth, I shall focus on objects at a particular time, and drop all temporal modifiers for presentational simplicity.) If M lacks rock *r* as a part, then M and M-minus share all their parts; and if they share all their parts, they coincide. Moreover, I shall assume that if M coincides with M-minus, then M lacks rock *r* as a part. Hence, M coincides with M-minus iff M lacks rock *r* as a part. Since it is indeterminate of M whether *r* is a part of it, it is indeterminate of M and M-minus whether they coincide. The third premise of the argument is that coinciding objects are identical. This premise may be backed in various ways. I shall focus on the simplest way, namely, to appeal to the intuition that distinct objects cannot fit into the same place at the same time, that distinctness of coinciding objects leads to overcrowding.<sup>9</sup> For this reason it is plausible that if M coincides with M-minus, then M is identical with M-minus. Since the converse obviously holds as well, M coincides with M-minus iff M is identical with M-minus. Since it was established earlier that it is indeterminate of M and M-minus whether they coincide, it follows that it is indeterminate of M and M-minus whether they are identical. Importantly, this statement of indeterminate identity is *de re*. The final premise of the argument is that the well-known Evans-Salmon argument shows successfully that there can be no *de re* indeterminate identity, contrary to what was established by means of the first three premises. Roughly, M-minus has the property of being indeterminately identical with M. But M lacks that property. Hence, M and M-minus are distinct.<sup>10</sup>

The argument may be summarized as follows:

- (1) It is indeterminate of M whether: it has *r* as a part. [P1]
- (2) There is an object, M-minus, such that it is determinate of M-minus that: it has all and only the parts of M that do not overlap with *r*. [P2]
- (3) It is determinate of M and M-minus that: the former coincides with the latter iff the former lacks *r* as a part.
- (4) It is indeterminate of M and M-minus whether: the former coincides with the latter.
- (5) It is determinate of M and M-minus that: the former coincides with the latter iff the former is identical with the latter. [P3]

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<sup>9</sup> A more complex reason for rejecting distinct coincidents is driven by the “grounding problem”; see, *inter alia*, Bennett 2004.

<sup>10</sup> See Evans 1978 and Salmon 1981. As Lewis (1988) pointed out, semantically indeterminate identity statements are not the target of the Evans-Salmon argument, but only *de re* indeterminate identity statements. Note further that the distinctness of M and M-minus may also be supported without identity-involving properties. M has the property of having *r* as an indeterminate part. But M-minus lacks that property. Hence, M is distinct from M-minus.

- (6) It is indeterminate of M and M-minus whether: the former is identical with the latter.
- (7) It is not indeterminate of M and M-minus whether: the former is identical with the latter. [P4]

This argument is an attempt at a *reductio* of the claim that M is a mereologically vague object, *via* the assumptions that there is an object, M-minus, that is composed of all of M except *r* (P2), that coinciding objects are identical (P3), and that Evans-Salmon-style reasoning establishes the incoherence of *de re* indeterminate identity (P4). I find each of these assumptions compelling, but I won't elaborate on their motivation.<sup>11</sup>

Summing up the considerations of this section, friends of fundamental indeterminacy *de re* face at least two worries. Many will judge the picture of fundamental metaphysical indeterminacy, conceptualized in terms of multiple actualities, a “crazy ontology.” Furthermore, mereological indeterminacy *de re* raises what I shall call the *problem of indeterminate coincidence*. In what follows, I shall develop a picture of mereological indeterminacy *de re* that avoids these worries. According to this approach, the indeterminacy is metaphysical and yet derivative.

### 3 Derivative Indeterminacy *De Re*

Here is the rough picture. The account of ordinary mereological indeterminacy to be proposed rests on a quasi-hylomorphic ontology of ordinary objects as material objects with multiple, “superimposed” individual forms. Each individual form of an ordinary object is, roughly, a total intrinsic profile. And all individual forms of an ordinary object differ minutely from each other—that is, the intrinsic profiles contain slightly different properties. These assumptions are consistent with the orthodox view that material objects are ultimately precise objects—that it is not fundamentally indeterminate of any material object and any property whether the former has the latter.

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<sup>11</sup> As an attempt to block the argument, consider replacing P3 by the following weaker premise, P3': [It is determinate of M and M-minus that: the former coincides with the latter] iff M is identical with M-minus. With P3', P1 and P2 do not lead to (6) below, and hence do not clash with (7). Intuitively, P3 has it that for any way *w* of making our world precise—for any precisificationally possible world *w*—if M and M-minus have the same mereological boundary according to *w*, then M is identical with M-minus according to *w*. P3', in contrast, has it that if M and M-minus have the same mereological boundary according to *all* ways of making our world precise, then M is identical with M-minus.

While weakening P3 in this fashion should be acknowledged as a way of blocking the argument, the move will strike many as *ad hoc*. If worries about distinct coincidents are worries about overcrowding, then it is hard to see why these worries should be limited in the way of P3'. Intuitively, distinct complex objects cannot fit into the same place at any time in any nomologically possible world and in any precisificationally possible world, irrespective of their spatial relationship at other times and in other worlds. Overcrowding is a local concern.

Given this ontology, I propose to construe ordinary mereological indeterminacy as *formal* indeterminacy *de re*. A mountain is formally indeterminate in its composition in virtue of having multiple mereological candidate-boundaries, where these candidate-boundaries are the boundaries encoded in different forms of the mountain. This indeterminacy in the mountain's composition is metaphysical, in that it does not have its source in representational imprecision, and it is nonfundamental, or derivative, in that it derives from perfectly precise facts about the composition of material objects.

To emphasize, this is not intended as an account of every instance of indeterminacy, not even of every instance of mereological indeterminacy, but merely as an account of certain familiar instances of mereological indeterminacy of ordinary objects. In what follows, this metaphysically harmless picture of vague ordinary objects will be developed in some detail and shown to provide a satisfactory answer to the problem of indeterminate coincidence.<sup>12</sup>

### 3.1 Ordinary objects with multiple individual forms

For any ordinary kind  $K$  (corresponding to the sortal concept of a  $K$ ), there are specific properties (and relations) of material objects that partially realize, or ground, the kind. Suppose, for example, that material object  $a$  has properties that jointly realize the kind *mountain*. Among its mountain-realizers are not only its specific shape and its specific altitude, but also the property of having a mereological and spatial boundary that is sufficiently contrasted from its environment. I shall call a  $K$ -realizing boundary of a material object a *K-boundary*. Comparing a mountain-shaped aggregate of rocks covered in snow with a mountain-shaped aggregate completely enclosed in a bigger aggregate of rocks, the former has a mountain-boundary, while the latter does not. This idea is rough but fairly intuitive.<sup>13</sup>

Moreover, for any ordinary kind,  $K$ , a *K-state* of a material object is a conjunctive fact about the object, which is associated with the kind in virtue of its constituent  $K$ -realizing properties (and that obtains at a particular time). A  $K$ -state of object  $a$  is the maximal conjunction of the facts that  $a$  has  $\varphi_1$ , that  $a$  has  $\varphi_2$ , ..., that  $a$  has  $\varphi_n$ , such that each  $\varphi_i$  is an intrinsic property of  $a$  or a property of  $a$  that realizes  $K$ . A  $K$ -state is an instantaneous, intrinsic and  $K$ -realizing profile of a material object. Some ordinary kinds are presumably completely realized by intrinsic properties of

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<sup>12</sup> This framework is developed in more detail and with further applications in Sattig *forthcoming b*. For an application of the framework to the problem of the many, see Sattig *forthcoming a*.

<sup>13</sup> It is likely that the sortal *mountain* is semantically imprecise. If so, different precisifications of the sortal determine different clusters of mountain-realizing properties. In particular, different precisifications specify different minimal degrees of boundary contrast, and hence specify different sets of eligible mountain-boundaries. While I claim that mereological indeterminacy as it occurs in the case of  $M$  does not have its source in the semantic imprecision of *mountain*,  $M$  may, in addition, be indeterminate in a way that does have its source in this semantic imprecision. The latter type of indeterminacy requires a separate treatment. As it will not play a role here, I shall assume that it is always a precise matter which properties realize which sortals, or kinds.

material objects, while others are partially realized by extrinsic as well as intrinsic properties. A mountain-state—in short, an *m-state*—of a material object *a* is a conjunctive fact that contains all intrinsic and mountainhood-realizing properties of *a* (at a given time), including *a*'s mountain-boundary.

K-states are instantiated by composite material objects. I shall make three metaphysical assumptions about these objects. First, composite material objects exist. Second, there is no fundamental metaphysical indeterminacy, and hence material objects, composite or not, are clear-cut. So it is not fundamentally indeterminate of any material object and any property whether the former has the latter. Third, composite material objects are mereological sums of material objects that overlap with a massive number of other composite material objects at any time, assuming mereological universalism.

On the assumption of mereological universalism, it seems plausible that given a mountain-shaped material object *a* with a certain mountain-boundary, there are many distinct material objects that massively overlap with *a* and that have more or less the same mountain-shape and mountain-boundary as *a*. Accordingly, any material object that is a subject of an m-state massively overlaps many other material objects that are also subjects of m-states with more or less the same intrinsic and realization profiles. This holds for K-states in general. I shall say that when distinct K-states, for the same K, obtaining at the same time are that similar, then they are *superimposed*.

Next, let me introduce the notion of *hosting*. For any K-state *s*, such that a composite material object *a* is either the subject of *s* or has a proper part that is the subject of *s*, *a* *hosts* *s*. The relation of hosting between a complex material object and multiple K-states is less intimate than instantiation. But hosting is far from arbitrary. For all the K-states hosted by a material object lie within the object's spatial boundary. While not strictly the subject, the material object is the "site" of these superimposed K-states.

Furthermore, for any range of massively overlapping material subjects of superimposed K-states—call these objects *K-objects*—there is, by the principle of mereological universalism, the fusion of all the massively overlapping K-objects—call this maximal fusion a *K-plus-object*. (Note that a K-plus-object may or may not be a K-object itself.) A K-plus-object hosts a plurality of superimposed K-states. In fact, a K-plus-object is the site of a maximal cluster of superimposed K-states.

With these assumptions about K-states and material objects in place, I shall characterize an *ordinary object* of kind K as a K-plus-object. An ordinary object of kind K thus hosts a plurality of superimposed K-states. All of these K-states lie within the material boundary of the object. In a hylomorphic spirit, I shall characterize a K-state hosted by an object of kind K as an *individual form* of that object. Ordinary objects are thus construed as having multiple individual forms. The multiple m-states hosted by a mountain are individual forms of this mountain. An m-state is a form of a mountain because it contains properties that realize mountainhood; and it is an individual form of a mountain because it is localized, a distribution of facts across a particular region of space (at a time). Notice that these different individual forms of an ordinary object do not reflect joints in nature: they are not needed to unify, to glue together, the parts of objects, a function forms are required to perform on Aristotelian conceptions. On Aristotelian hylomorphism, an ordinary object could

not have multiple forms. The point of the multiplication of forms in the present quasi-hylomorphic picture is a very different one.<sup>14</sup>

### 3.2 Formal indeterminacy *de re* and absolute determinacy *de re*

Having paired ordinary objects with multitudes of individual forms, let us turn to ordinary statements of determinacy and indeterminacy about such objects. I shall begin with a distinction between two modes of predication that manifest different perspectives on ordinary objects. Then I shall draw a corresponding distinction between two notions of determinacy and indeterminacy *de re*.

We may conceive of ordinary objects from different *perspectives* in different contexts. These perspectives correspond to different psychological methods of individuating ordinary objects. We can adopt the *sortal-sensitive* perspective and think of an object as belonging to a specific ordinary kind. To do so is to recognize that the object's properties and relations realize that kind. But we can also adopt the *sortal-abstract* perspective and think of an object in abstraction from any ordinary kinds to which it belongs. To do so is to think of the object just as a material object and to ignore which kinds (if any) its properties and relations realize. The sortal-sensitive perspective is the perspective of unreflective common sense which parses the world into mountains, trees, clouds and other ordinary objects. The sortal-abstract perspective is the perspective of metaphysicians who ask what objects are really like, and who, accordingly, don't pay attention to sortal representation.

To a type of perspective on objects corresponds a *mode of predication*, a certain way of predicating a property (or relation) of an object. First, some terminology. By adopting the sortal-sensitive perspective on an ordinary object, a speaker employs the *formal* mode of predication when describing the object. By adopting the sortal-abstract perspective on an ordinary object, a speaker employs the *absolute* mode of predication when describing the object.<sup>15</sup>

How are these modes of predication represented syntactically? Consider a monadic predication '*o* is F' about an ordinary object *o* (the extension to polyadic predications is straightforward). This predication may be read in two different ways, as an absolute predication and as a formal predication. If '*o* is F' is read as an absolute predication, then it has the familiar logical form 'F(*o*)'. If '*o* is F' is read as a formal predication, then it has the logical form 'F(*o*)<sub>form</sub>'. Henceforth, I shall specify these readings informally, as '*o* is absolutely F' and '*o* is formally F'.

How do these modes of predication work semantically? The semantics of absolute predication will be taken as understood. Formal predication is a mode of predicating a property of material objects with individual forms. While predications in the absolute mode about an object *o* are made true by facts concerning which properties are instantiated by *o* itself, predications in the formal mode about *o* are made true by facts concerning which properties are contained in a given individual

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<sup>14</sup> See, inter alia, Koslicki (2008) on Aristotelian and neo-Aristotelian hylomorphism about ordinary objects.

<sup>15</sup> This is a simplification of the distinction between three perspectives and corresponding modes of predication in Sattig 2010 and *forthcoming b*.

form of  $o$ . The formal mode requires the specification of an individual form for a predication to be evaluated for truth—that is, a formal predication is evaluated relative to a particular individual form of its material subject. Relative to an individual form  $i$  of an ordinary object  $o$ ,  $o$  is formally F iff  $i$  contains the property of being F. For example, relative to individual form  $i$  of  $o$ ,  $o$  formally has the property of having a certain object as a part iff  $i$  contains the property of having that object as a part. Given that an ordinary object,  $o$ , has multiple individual forms, the simple formal predication ‘ $o$  is formally F’ is not truth-evaluable, since no particular individual form is specified relative to which the predication may be evaluated. It should be emphasized that the formal mode of predication does not correspond to a metaphysically basic mode of instantiating a property, in addition to the absolute mode of instantiation corresponding to the absolute mode of predication. Predications that are syntactically in the formal mode are made true by facts concerning the absolute instantiation of properties.<sup>16</sup>

Corresponding to the distinction between two modes of predication, absolute and formal, I shall distinguish between two notions of determinacy and indeterminacy, absolute and formal. I shall make two preliminary assumptions. First, to say that it is indeterminate whether  $o$  is F is to say that it is neither determinate that  $o$  is F nor determinate that  $o$  is not F. Second, ‘it is determinate that’ functions syntactically as a sentential operator. Corresponding to the absolute mode of predication there is an operator of absolute determinacy: it is absolutely determinate that  $o$  is absolutely F— $\Delta(F(o))$ . Corresponding to the formal mode of predication there is an operator of formal determinacy: it is formally determinate that  $o$  is formally F— $\Delta_{\text{form}}(F(o)_{\text{form}})$ . Just as the different modes of predication are associated with different perspectives on the world of objects, so are the different notions of determinacy and indeterminacy. We can represent an object as belonging to a particular kind and ask whether it has an indeterminate formal boundary. Or we can abstract from any sortal representation of an object and ask whether it has an indeterminate absolute boundary.

The central notion for present purposes is that of formal indeterminacy *de re*. So I shall begin my explication here. Formal determinacy and indeterminacy *de re* are grounded in the multitude of an ordinary object’s superimposed individual forms. An individual form of an ordinary object  $o$  is a complex fact, and hence contains properties (and relations). As we saw, a monadic predication in the formal mode, ‘ $o$  is formally F’, is true relative to an individual form  $i$  of  $o$  just in case  $i$  contains the property of being F. Now, a monadic statement of formal determinacy *de re*, employing the formal mode of predication, ‘It is formally determinate of  $o$  that: it is formally F’, is true simpliciter just in case ‘ $o$  is formally F’ is true relative to each individual form of  $o$ —that is, just in case each individual form of  $o$  contains the property of being F. Truth conditions of monadic statements of formal determinacy and indeterminacy *de re* may then be stated as follows:

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<sup>16</sup> This account of formal predications of properties may, with a bit of work, be extended to formal predications of relations. It will be assumed, however, that numerical identity can only be predicated absolutely. This simplifying assumption is made here because there is no need in the present context for formal predications of identity. For such predications, see Sattig 2010 and *forthcoming b*.

(T1)

It is formally determinate of  $o$  that: it is formally F iff each of  $o$ 's individual forms contains the property of being F.

It is formally determinate of  $o$  that: it is formally not F iff none of  $o$ 's individual forms contains the property of being F.

It is formally indeterminate of  $o$  whether: it is formally F iff some but not all of  $o$ 's individual forms contain the property of being F.

So statements of formal determinacy and indeterminacy *de re*, employing the formal mode of predication, are made true by facts concerning which properties are contained in which of the subject's many superimposed individual forms. The matching properties of an object  $o$ 's individual forms, those all individual forms contain, are  $o$ 's formally determinate properties. More importantly, the differing properties of  $o$ 's individual forms, those some but not all individual forms contain, are  $o$ 's formally indeterminate properties.

Statements of formal determinacy and indeterminacy about an object  $o$  may be sensitive to which sortal concept  $o$  is conceived under in a given context. One might hold that one and the same object may fall under different sortal concepts. One might hold, for example, that a statue is also a lump of clay, and that a mountain is also an aggregate of rocks. If so, an object may be thought of under different sortal concepts in different contexts. The individual forms of an object of kind K are the complex K-realizing states, the K-states, hosted by that object. Since different sortal concepts are realized by different properties, an object has different pluralities of individual forms relative to different sortal representations. And given that formal determinacy and indeterminacy *de re* are a matter of similarity and difference among an object's individual forms, which properties are formally determinate and which formally indeterminate may vary with respect to which sortal concept is in play in which context. While more could be said about this context sensitivity, I only mention it to set it aside. It won't play a role here.

It is obvious that formal indeterminacy is structurally similar to supervaluational indeterminacy. The standard supervaluationist account of 'It is indeterminate whether:  $o$  is F' supervaluates over the different candidate referents of ' $o$ ' (§1). Recall also that the modal gloss of the fundamental account of 'It is indeterminate of  $o$  whether: it is F' supervaluates over the different qualitative profiles instantiated by  $o$  in various actual worlds (§2). By contrast, the present account of 'It is formally indeterminate of  $o$  whether: it is F' supervaluates over the different K-states, for some kind K, hosted by  $o$  in the unique actual world.

A well-known virtue of supervaluationism is that it preserves the logical truths of classical logic. Even if it is supervaluationally indeterminate whether  $o$  is F—because, say, the term ' $o$ ' is imprecise and has multiple candidate referents—it is still supervaluationally determinate that either  $o$  is F or  $o$  is not F, because no matter which candidate referent is assigned to the term ' $o$ ', this object is either F or fails to be F. Analogously, the account of formal indeterminacy preserves the classical tautologies. Even if it is formally indeterminate of  $o$  whether: it is formally F—

because some but not all individual forms of  $o$  contain the property of being F—it is still formally determinate of  $o$  that: either it is formally F or it is formally not F, because each individual form of  $o$  either contains the property of being F or fails to do so.<sup>17</sup>

While this semantic picture takes care of ordinary, sortal-sensitive discourse that explicitly concerns the determinate and indeterminate properties of objects, there is a worry that the picture leaves apparently simple ordinary predications, such as ‘M formally has at least mass  $m$ ’, standing in the rain. For given that mountain M has multiple individual forms, and given that a formal predication can only be evaluated for truth relative to a specific individual form, such predications don’t seem to be truth-evaluable. My response is that ordinary predications such as this one are truth-evaluable, on the assumption that they are implicitly modified by the formal-determinacy operator, yielding the explicit form ‘It is formally determinate of M that: it formally has at least mass  $m$ ’.

Formal indeterminacy *de re* is both metaphysical and derivative. It is metaphysical in the sense that it doesn’t have its source in representational imprecision, such as imprecision of linguistic meaning. Statements of formal indeterminacy *de re* are made true by facts about ordinary objects, not by facts about representations of ordinary objects. While the standard supervenience truth conditions of indeterminacy claims concern different ways of specifying the semantic values of linguistic expressions, and hence locate the indeterminacy in language, the present truth conditions of singular claims of indeterminacy locate the indeterminacy in reality, namely, in the differences among an ordinary object’s multiple individual forms—just as the modal truth conditions of the fundamental account locate the indeterminacy in reality, namely, in the differences among an ordinary object’s multiple qualitative profiles in different actualities. Furthermore, formal indeterminacy *de re* is nonfundamental, or derivative, in the sense that facts about such indeterminacy are grounded in more basic, indeterminacy-free facts about superimposed K-paths, and in the sense that superimposed K-paths, the individual forms of ordinary objects, do not, unlike Aristotelian forms, carve nature at the joints. Formal indeterminacy *de re* doesn’t run deep.

This is the main part of the story. It remains to add a word about the semantics of statements of *absolute* determinacy *de re*. With the assumption in the background that material objects are precise, I shall give a deflationary account of the notion of absolute determinacy *de re*, according to which the operator ‘It is absolutely determinate that’ is redundant: for any ordinary object  $o$ ,

(T2)

It is absolutely determinate of  $o$  that: it is absolutely F iff  $o$  is absolutely F.

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<sup>17</sup> The picture sketched here is merely the beginning of a reductive account of formal indeterminacy *de re*. One loose end is the problem of higher-order indeterminacy—the problem of whether the categorization into determinate parts, determinate nonparts and indeterminate parts of mountains may itself be indeterminate. An adequate discussion of this problem lies beyond the scope of this essay.

It follows that it cannot be true of any ordinary object  $o$  that it is neither absolutely determinate that  $o$  is absolutely F nor absolutely determinate that  $o$  is absolutely not F. That is, ordinary objects cannot be absolutely vague. While the availability of true ordinary claims of formal indeterminacy *de re* are our primary concern when analysing mereological indeterminacy of ordinary objects, the availability of true claims of absolute determinacy *de re* will come into play in response to the problem of indeterminate coincidence below.

### 3.3 Vague ordinary objects

We saw that as an alternative to construing indeterminate mereological boundaries of ordinary objects such as mountains as *de dicto* and as deriving from imprecision of our representational apparatus, such indeterminacy may be construed as *de re* and as arising independently of imprecision of representations of objects. While ordinary mereological indeterminacy *de re* is usually understood as fundamental indeterminacy *de re*, the present framework allows ordinary mereological indeterminacy *de re* to be understood as mere derivative indeterminacy *de re*. I shall now state my proposed analysis of the claim that

(IND) It is indeterminate of M whether: it has rock  $r$  as a part (at  $t$ ),

and then point out advantages of this analysis over the rival discussed earlier.

First, it is plausible that (IND) manifests the sortal-sensitive perspective on objects. That is, in the contexts in which this claim is made M is conceived of as a mountain. Intuitively, it is indeterminate whether M has rock  $r$  as a part because different surfaces, some including  $r$ , some excluding  $r$ , are equally good candidates to be the boundary of the mountain. So let us ask further why we take the different surfaces to be equally good candidates to mark M's boundary. The answer seems to be that each surface preserves what makes M a mountain. In the present terminology, each surface preserves M's mountainhood-realizing properties. Without sortal guidance, we would be unable to distinguish alternative boundaries of an object. Thus, our judgement that M has an indeterminate mereological boundary is sensitive to M's being a mountain. Given that statements of indeterminacy *de re* manifesting the sortal-sensitive perspective employ the formal mode of predication and the corresponding formal notion of indeterminacy, our ordinary attribution of an indeterminate mereological and spatial boundary to M may be clarified as follows:

(IND<sub>form</sub>) It is formally indeterminate of M whether: it formally has rock  $r$  as a part (at  $t$ ).<sup>18</sup>

It will now be shown that statement (IND<sub>form</sub>) may be true in the present framework. We assumed earlier that material objects are fundamentally clear-cut, and hence that it is fundamentally determinate of material objects which things they are

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<sup>18</sup> More perspicuously, it is formally indeterminate of M and the property of having  $r$  as a part whether the former instantiates the latter.

absolutely composed of. In the case under discussion, there is an m-plus-object that massively overlaps with many m-objects—call one of these aggregates of atoms ‘A’—and that, accordingly, hosts a cluster of superimposed m-states. By the ontology of ordinary objects stated above, the m-plus-object is a mountain—let it be M—that hosts a cluster of superimposed m-states, its individual forms. These individual forms are distributions of absolutely determinate facts across clear-cut material objects, namely, M and proper parts of M.

Let us assume, next, that one individual form of M includes the fact that M is composed of the *x*s, whereas another individual form of M includes the fact that A, a proper part of M, is composed of the *y*s, where the *x*s and the *y*s are distinct but overlap massively, in that rock *r* is one of the *x*s but not of the *y*s.<sup>19</sup> As a consequence of the foregoing specifications, M’s multiple individual forms differ with respect to which mereological properties they contain. By truth conditions (T1) of statements of formal determinacy and indeterminacy *de re*, it is formally indeterminate whether M is formally composed of the *x*s or of the *y*s. In particular, it is formally indeterminate whether M formally has *r* as a part. Hence, (IND<sub>form</sub>) is true. Since M’s indeterminate formal boundary arises merely from mereological differences among its multiple individual forms, (IND<sub>form</sub>) is compatible with the fact that it is absolutely determinate that M absolutely has rock *r* as a part. On this double-layered picture, M is a formally vague but absolutely precise object. What holds for M holds for other ordinary objects. Their indeterminate boundaries are derivative, the result of differences among their many superimposed forms, floating above the clear-cut boundaries of their underlying matter.

What speaks in favor of this derivative account of mereological indeterminacy *de re* in comparison with the fundamental account? First, those who are drawn to indeterminacy *de re* but oppose fundamental indeterminacy *de re* on the grounds that a picture of reality as having multiple precisifications is unacceptably radical should welcome an account of indeterminacy *de re* as derivative, as arising from a perfectly precise reality, just as orthodoxy conceives of it. This is an intuitive advantage. Moreover, those who recognize a distinction between fundamental and derivative facts should be restrictive about which facts are fundamental. They should accept the methodological principle that fundamental facts must not be multiplied without necessity.<sup>20</sup> Accordingly, the proposed account of indeterminacy *de re* as derivative has a methodological edge over the standard account of indeterminacy *de re* as fundamental. Of course, which account is ultimately preferable depends on how they compare along other dimensions as well.

Second, the framework offers a plausible response to the problem of indeterminate coincidence, which is not available to the fundamental account of mereological indeterminacy *de re*. The argument from indeterminate coincidence against vague objects was earlier summarized as follows:

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<sup>19</sup> For ease of exposition, I am here treating the properties of being composed of the *x*s and of having *r* as a part as complex monadic properties, ignoring individual forms of the *x*s and of *r*. Ultimately, the framework should be able to handle relational formal predications of parthood that are sensitive to the individual forms of all of its relata.

<sup>20</sup> Schaffer (2009: 361) suggests that a principle along these lines should replace Occam’s Razor, according to which entities must not be multiplied without necessity.

- (1) It is indeterminate of M whether: it has *r* as a part. [P1]
- (2) There is an object, M-minus, such that it is determinate of M-minus that: it has all and only the parts of M that do not overlap with *r*. [P2]
- (3) It is determinate of M and M-minus that: the former coincides with the latter iff the former lacks *r* as a part.
- (4) It is indeterminate of M and M-minus whether: the former coincides with the latter.
- (5) It is determinate of M and M-minus that: the former coincides with the latter iff the former is identical with the latter. [P3]
- (6) It is indeterminate of M and M-minus whether: the former is identical with the latter.
- (7) It is not indeterminate of M and M-minus whether: the former is identical with the latter. [P4]

The proposed framework allows this argument to be blocked in the following way. As pointed out earlier, premise P1 manifests the sortal-sensitive perspective. We judge M's boundary to be unclear, because there are several boundaries that preserve what makes M a mountain. Accordingly, P1 is to be read as a formal predication:

P1\* It is formally indeterminate of M whether: it formally has *r* as a part.

Premise P2 also manifests the sortal-sensitive perspective, since the boundary of M-minus is recognized relative to the boundary of M. We pick out M-minus as the object that is just like M, except for determinately lacking *r*. Let us call an object, such as M-minus, that is all of a given mountain except for one or more of its indeterminate parts, a *mountain\**. In virtue of its sortal sensitivity, P2 is to be read as a formal predication:

P2\* There is an object, M-minus, such that it is formally determinate of M-minus that: it formally has all and only the parts of M that do not overlap with *r*.

Premise P3 incorporates the principle that distinct objects cannot coincide, which owes its intuitive appeal to a worry about overcrowding. This is a metaphysical worry: that distinct objects cannot fit into the same place at the same time is supposed to be a truth about the world that is independent of how the world is represented. P3 thus manifests the sortal-abstract perspective on the world of objects, the perspective that cuts through sortal representations, and accordingly is to be read as an absolute predication:

P3\* It is absolutely determinate of M and M-minus that: the former coincides absolutely with the latter iff the former is absolutely identical with the latter.

It is important that P3\* is a claim about absolute coincidence, as opposed to formal coincidence.<sup>21</sup>

Premise P4 is driven by the Evans-Salmon argument, which is intended as an argument against metaphysically indeterminate identity. That is, the argument's conclusion is supposed to be a truth about the world that is independent of how the world is represented. P4 thus manifests the sortal-abstract perspective and is to be read as an absolute predication:

P4\* It is not absolutely indeterminate of M and M-minus whether: the former is absolutely identical with the latter.<sup>22</sup>

If P1-P4 are read as P1\*-P4\*, then these premises are jointly consistent. According to the present ontology, an ordinary object of kind K is a K-plus-object, the fusion of all K-objects from a range of massively overlapping K-objects. M is thus an m-plus-object, and accordingly hosts multiple m-states—multiple individual forms. Some of these m-states contain the property of having *r* as a part; others do not contain this property. This makes P1\* true.

Let us say, furthermore, that while an m-plus-object is the maximal fusion of all m-objects from a range of massively overlapping ones, an *m\*-object* is any *nonmaximal* fusion of massively overlapping m-objects. And let a mountain\* be an m\*-object. Intuitively, a mountain\* is all of a mountain except for one or more of its formally indeterminate parts. Now let M-minus be the fusion of all of the m-objects in M except for those that overlap with *r*. Accordingly, M-minus hosts all and only those individual forms of M that fail to contain the property of overlapping with *r*. This makes P2\* true.

From P2\* it follows that M coincides formally with M-minus iff M formally lacks *r* as a part. Since, by P1\*, it is formally indeterminate of M whether: it formally has *r* as a part, it is then also formally indeterminate of M and M-minus: whether the former coincides formally with the latter. It does not follow, however, that it is absolutely indeterminate of M and M-minus whether: the former coincides absolutely with the latter. For on the assumption made in the previous section that material

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<sup>21</sup> The notion of coincidence was earlier introduced as follows: material objects *x* and *y* coincide =<sub>df</sub> for any place *p*, *x* occupies *p* iff *y* occupies *p*. Given the distinction between the absolute and the formal mode of predication, we get absolute versus formal coincidence: for any material objects *x* and *y*,

(C<sub>abs</sub>) *x* coincides absolutely with *y* =<sub>df</sub> for any place *p*, *x* absolutely occupies *p* iff *y* absolutely occupies *p*.

(C<sub>form</sub>) *x* coincides formally with *y* =<sub>df</sub> for any place *p*, *x* formally occupies *p* iff *y* formally occupies *p*.

<sup>22</sup> On the assumption that identity statements have only an absolute reading, this is the only sensible reading of P4 available. But even if a formal reading of identity statements were available, the absolute reading would be the intended one, because the Evans-Salmon argument is meant to be an argument against metaphysically indeterminate identity.

objects are metaphysically clear-cut, M and M-minus are absolutely distinct objects with slightly different absolute mereological and spatial boundaries. The indeterminate formal coincidence of M and M-minus is compatible with their determinate absolute noncoincidence. Accordingly, P1\* and P2\* do not yield absolutely indeterminate identity of M and M-minus via P3\*. And so no clash with P4\* occurs.

Let me sum up the foregoing discussion. The problem of indeterminate coincidence, directed against vague ordinary objects, rests on the metaphysical worry that it cannot be indeterminate of distinct objects whether they coincide. The combination of a derivative account of formal indeterminacy *de re* with the possibility of perspectival shift between formal and absolute claims of determinacy and indeterminacy *de re* allows us to endorse the absolute ban on indeterminate coincidence of distinct objects, while still leaving room for indeterminate coincidence of another type. It is formally indeterminate of M and M-minus whether: they coincide formally. However, when M and M-minus are described absolutely, from the sortal-abstract perspective, then there are no indeterminate boundaries, and hence no indeterminate coincidence.<sup>23</sup>

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