Shieva Kleinschmidt

University of Southern California

Multilocation and Mereology

Multilocation and Minimal Mereology do not mix well. It has been pointed out that Three-Dimensionalism, which can be construed as multilocation-friendly, runs into trouble with Weak Supplementation.[1] But in fact, regardless of one's theory of persistence, if someone posits the possibility of any one of several kinds of multilocation, he or she will not be able to maintain the necessity of any of the three axioms of Minimal Mereology: the Transitivity of Proper Parthood, the Asymmetry of Proper Parthood, and Weak Supplementation.[2] In fact, positing even the mere conceivability of cases involving multilocation will require the denial of the analyticity of Minimal Mereology. In response to this, some have claimed that we ought to relativise parthood, either to one region or to two. Unfortunately, if we replace the axioms of Minimal Mereology with region-relativised counterparts, we will not be able to capture the intuitions that supported the original axioms. In what follows I will argue for the incompatibility of this plausible picture of parthood and liberalism about location, then I will consider the region-relativising response that involves adopting an analogous logic of parts and wholes which uses region-indexed parthood, and I will argue that this analogous logic fails to capture the spirit of the original. The only adequate solution, I maintain, is to restrict multilocation to a domain outside the scope of the rules we intuitively take to govern the parthood relation. For those who take Minimal Mereology to be necessary and universal, that will mean relinquishing the possibility of multilocation.

1. Appealing Parthood and Traditional Location

The three claims that constitute the axioms of Minimal Mereology are exceptionally intuitive and widely accepted. They are as follows.

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[1] Effingham and Robson 2007, and Gilmore 2009.

[2] This has also been discussed in Maureen Donnelly's excellent 2010. Also, I am following Achille Varzi's usage of 'Minimal Mereology' (Varzi 2003).

An Appealing Picture of Parthood:

- ***Transitivity of Proper Parthood*:** Necessarily, for any objects, *x*, *y*, and *z*, if *x* has *y* as a proper part and *y* has *z* as a proper part, then *x* has z as a proper part.

So, for instance, if my hand is a proper part of my arm, and my arm is a proper part of my body, then my hand must be a proper part of my body.

- ***Asymmetry of Proper-Parthood*:** Necessarily, for any objects, *x* and *y*, if *x* is a proper part of *y*, then it's not the case that *y* is a proper part of *x*.

So if my hand is a proper part of me, then it follows that I am not a proper part of my hand.

- ***Weak Supplementation*:** For any objects, *x* and *y*, if *y* is a proper part of *x*, then there exists a *z* such that *z* is a proper part of *x* and *z* is disjoint from *y*.

The idea here is simply that if we have only some of something, then there must be more of it, which is separate from what we already have.

The traditional theory of location is a bit more controversial. First, a note on my use of *located at*: I will be following Hud Hudson in his use of this phrase as picking out a primitive relation. According to Hudson, any object that is *located at* a region completely fills that region, and is the same size as the region. E.g., I am not located at my office, or at this universe, even though I am in my office, and in this universe. Rather, I'm located at the me-shaped, me-sized region that's right *here*, where I'm at. (If we identify ourselves with spacetime worms, the regions we're located at will be four-dimensional.) Finally, I'm not, strictly speaking, located at the region my hand is located at; when speaking loosely we may claim I'm located at that region, but really, any location relation I bear to the region is derivative, instantiated in virtue of my having a proper part that is genuinely located at the region.[3]

Objects are typically thought to be neatly paired with regions. That is:

The Traditional Picture of Location:

(i) Every object gets one and only one region where it's located (i.e., even though objects are typically within or overlap many regions, there is only one place we would say is, strictly speaking, any given object's location), and

[3] Hudson 2006, 98-99. The claims about mere-derivative location were presented to me by Hudson in conversation.

(ii) Every region gets at most one object located at it (i.e., though there may be many objects within a given region, and many objects that overlap the region, for any region, point-sized or extended, there is only one object that is exactly where the region is).

One way of denying the Traditional Picture is to claim that objects can have more than one region at which they're located[4]. That is, by positing multilocation:

- '*x* multilocates' =df *x* is a material object that is wholly located at more than one region.[5]

This talk of being *wholly located* at regions is often used in discussions of persistence. Four-dimensionalists think we're spread through time in the same way we're spread through space, with proper temporal parts at each time. Three-dimensionalists think we persist in virtue of being *wholly present* at each time. It seems, they claim, that we can just tell that we're wholly present – we can look down and see, none of us is missing, all of our parts are here. A three-dimensionalist who thinks non-present objects exist is going to posit multilocation of persisting objects through spacetime – those objects will be wholly present at more than one spacetime region. They are multilocated across time. The four-dimensionalist, on the other hand, will typically (though they needn't) say that each object is wholly present at a single spacetime region.

There are many kinds of multilocation, and many reasons one might posit its possibility. Even those who think Three-Dimensionalism of the sort just mentioned is *merely possible* will thereby posit the possibility of multilocation.[6] Though there are reasons to posit multilocation independent of questions of persistence (and compatible with Four-Dimensionalism). Hud Hudson has posited multilocation in response to the Problem of the Many.[7] And Raul Saucedo has argued that due to recombination principles we should think the location relation can be many-one between regions and

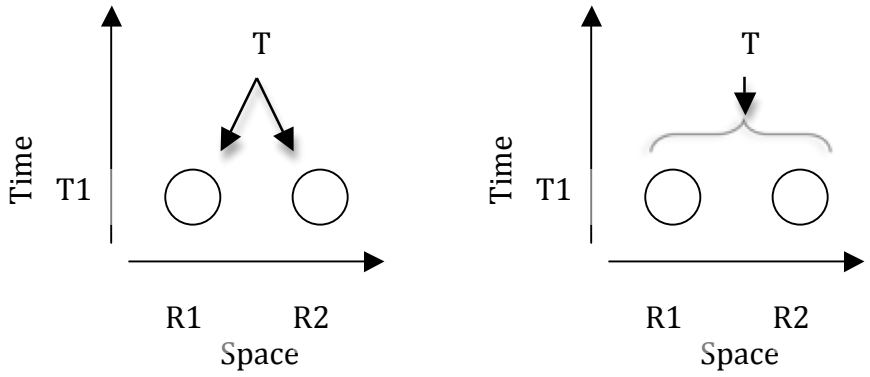
[4] I will be using 'wholly located at' and 'located at' synonymously.
[5] This differs from the definition offered in Hud Hudson 2006, on which a multilocating entity cannot be located at the fusion of all of the regions at which it is wholly located.
[6] For reasons for the three-dimensionalist to posit the possibility of simultaneous multilocation, see Kleinschmidt 2011.
[7] See Hudson 2001, chapter 2, and Wasserman 2003 for a critique.

their occupants.[8] And one may simply think that the location relation should roam free, and that we should only restrict it if we have good reason to.

Finally, one might claim objects (or their temporal parts[9]) can be located at more than one region at the same time in time-travel cases. They may claim this in order to avoid *time-traveller's bloat*, which results from applying the following theory to time-travel cases:

- **Bloat Theory:** if an entity is present at a time, *t*, then it (or its entirely present temporal part, if the entity is not entirely present at *t*) is located, at *t*, merely at the fusion of all the regions it fills at *t*.

So suppose that time-travelling Tom goes back in time to visit himself at *t*. If we endorse Bloat Theory, then instead of being able to say that Tom (or his temporal part) is wholly located at each of two regions at *t*, we will have to say he's spread across them. We will have to claim that, at least strictly speaking, Tom at *t* has bloated to roughly twice the size we intuitively took him to be.



[8] Saucedo, forthcoming. See also McDaniel's 2007 argument from recombination for the possibility of extended simples.

[9] The traditional definition of temporal parts precludes their being multilocated. According to it, a temporal part of an object at a time is the fusion of all of the instantaneous spatial parts the object has at that time (Sider, 2001). There is a natural, multilocation-friendly definition:

- ***x* is a *temporal part* of *y*** =df (i) *x* is wholly located at *r**, which is the intersection of *r* and *t*, (ii) *y* is wholly located at *r*, and (iii) *x* is part of *y*. (Based on the definition in Thomson 1983, 207.)

Unfortunately, this definition fails to capture what we think of as objects at times, as shown by two different cases. In the first, presented by Nikk Effingham (2011), a time-travelling ghost of a person spatially coincides with a proper spatial part of that same person at that time. In this case, what is intuitively the maximal spatial part of the ghost at that time will not count as a temporal part of the person at that time, because it fails to meet condition (i). In the second case, presented in conversation by Jake Ross, a ghostly post-it with a red right half and a blue left half is folded so that the halves colocate. Each of the halves of the post-it will thus count as temporal parts of the post-it at the times at which it is folded. Note, however: if we respond to these cases by denying that temporal parts can be multilocated, then if we think objects can ever be multilocated, such an object would be smaller than its temporal part at any time it multilocates.

Both three- and four-dimensionalists may wish to reject Bloat Theory, and rejecting it seems to be a particularly good idea for the three-dimensionalist. However, I shall forego discussion of why, as well as any further discussion of motivation for the endorsing the possibility of multilocation. (For such discussion, see Kleinschmidt 2011.) In what follows I will present three ways of being multilocated, and will appeal to what seem to be metaphysically possible cases of time-travel to both illustrate how such multilocation might work and to provide support for its possibility. (I will assume our multilocation theorist rejects Bloat Theory.)[10] I will show how the first kind of multilocation raises trouble for the Transitivity of Proper Parthood and the Asymmetry of Proper Parthood, and how the final two kinds of multilocation raise trouble for Weak Supplementation.

2. Embedded Mediated Multilocation

Consider a slightly complicated way of multilocating, described by the following.

- **Claim 1:** It is possible that there exist some objects, *x* and *y*, and regions *r1*, *r2* and *r3*, such that *x* is exactly located at *r1*, *y* is exactly located at *r2*, *x* is exactly located at *r3*, and *x* is (at *r1*) a proper part of *y* (at *r2*) which is (at *r2*) a proper part of *x* (at *r3*).

This kind of multilocation involves an object that's located within another object, which is located within it. Further, the first object is a proper part of the second, which is a proper part of it. Here's a case to illustrate this.

[10] These cases are fairly innocent: they don't require changing the past or causal loops, and don't generate paradoxes. In all of my cases, we can take all of the atoms constituting the time-traveller to be replaced (perhaps gradually) pre-time-travel by atoms that have just come into temporal presence, so that no atom is present at a time more than once. We can thereby give a complete story of fundamental causal relations (assuming macroscopic causes are reducible to microscopic ones) without invoking any causal loops. My cases do not even require discontinuous motion: I allow for the possibility that the time-travel is due to spacetime looping properly, so that all an object has to do to be present at the same time more than once is to persist long enough.

Meet Clifford. Clifford is a handsome dog statue who was lovingly made from smaller statues. He has Kibble, a statue of a biscuit, as a proper part that makes up his torso. Kibble also has statues among its proper parts, including Odie, a solid dog-statue who makes up most of Kibble. Clifford is an outside dog, and after 20 years of sitting in the sun three things happened: (i) he melted a bit, making Clifford a solid, continuous mass. Unfortunately this has resulted in Clifford no longer having any statues as proper parts; none of them could remain after melting together. But Clifford survived, since most of the same matter stuck around. (ii) Next, all of the atoms that once made up Clifford were slowly replaced by new ones. But this change happened a little bit at a time. (iii) Like a raisin in the sun, Clifford shrank quite a bit, and many of his atoms left for good. Over the course of 20 years, Clifford came to be about a third of his original size. But again, the change was quite slow, and Clifford was resilient. One day, God looked down and said, "Clifford, you've been a good boy. I'm going to let you go on an adventure. I'm going to let you travel back in time to just before you were created." Perhaps Clifford was helped to move discontinuously, or perhaps spacetime was simply looped, providing a path to the past a dog-statue could follow. But one way or another, Clifford ended up sitting on a shelf, visiting this earlier time and occupying exactly the region that had been occupied by Odie. Then an artist came along and saw him and said, "I know just what to do with you!" The artist used Clifford to make up most of Kibble, just like Odie. In fact, Odie and Clifford didn't share just these properties, they shared all of their properties: they're one and the same dog-statue! So Clifford was located within Kibble, which was located within Clifford.

When we started describing the case we noted that Odie was a proper part of Kibble, which was a proper part of Clifford. Finding out that Odie is actually a time-traveller shouldn't change the parthood relations we say he stands in at that time

(especially if we think that time-travellers don't bloat: i.e., we think Odie is, in fact, wholly located at the small region within Clifford). So we ought to claim that Clifford/Odie is a proper part of Kibble, which is a proper part of Clifford. However, this is clearly problematic. It is in obvious conflict with the Transitivity of Proper Parthood.

3. The Transitivity of Proper Parthood

Recall, the Transitivity of Proper Parthood says that, necessarily, for any objects *x*, *y*, and *z*, if *x* is a proper part of *y*, and *y* is a proper part of *z*, then *x* is a proper part of *z*. In our case, Clifford is a proper part of Kibble, which is a proper part of Clifford. If we endorse Transitivity of Proper Parthood, then it follows that Clifford is a proper part of Clifford. But nothing can be a proper part of itself – proper parts are parts that are distinct from their wholes. So, the Clifford/Odie case involves an outright violation of the Transitivity of Proper Parthood.

One response to this is to relativise parthood, and therefore also the Transitivity of Proper Parthood, to regions. There is disagreement about how many regions to relativise to, and about which regions they should be. I will restrict myself to looking at just two accounts, one according to which we should relativise parthood to a single region, and one (which I take to be the most plausible way to doubly-relativise parthood) according to which we should relativise it to two regions.[11]

The first account I shall consider is from Hudson, who claims we should index parthood to a single region which both contains (or is identical to) a region at which the part is wholly present, and is contained by (or identical to) a region at which the whole is wholly present.[12] Instead of saying simply that *x* is a part of *y*, now we should say *x* is a part of *y* at *r*.[13]

Alternatively, we can relativise parthood to two regions, the first being a region the part is located at, the second a region the whole is located at.[14] So "*x* is a part of *y* at *r*" would instead be "*x* is at *r1* a part at *r2* of *y*", (where *r1* picks out a region at which *x* is

[11] For problems for alternative ways of relativising parthood to a single region, as well as additional worries for the single-region-relativising account I consider below, see Donnelly's 2010.
[12] 2001 67.
[13] I have two reasons for rejecting singly-relativised parthood. First, it fares even worse than doubly-relativised parthood in capturing our intuitions behind the axioms of Minimal Mereology. Second, it leaves us without the means to distinguish between cases which are, intuitively, distinct. I will discuss details of the former worry below. For discussion of the latter, see Kleinschmidt 2011.
[14] This response was independently developed and presented in Gilmore's 2009.

located, and *r2* picks out a region at which *y* is located); or, perhaps more perspicuously, "*x* at *r1* is a part of *y* at *r2*". Though this second formulation is more clear, it is potentially misleading: it gives the impression that e.g., '*x* at *r1*' is a name picking out a different entity from '*x* at *r2*', and that this kind of "relativisation" actually involves differentiating between distinct objects rather than indexing parthood. But the intent is that the parthood relation really is indexed to two regions, and the relata of the relation really can be identical, even if the relata are located at distinct regions.[15]

Indexing parthood to regions is independently motivated by the generalised Problem of Intrinsics[16], which arises in cases of multilocation where an entity seems to have some property[17], *F*, at one region at which it is located, but lack *F* at another region at which it is located. For instance, time-travelling Tom weighs *n* pounds in the kitchen at time *t*, and (*n*+20) in the living-room at *t*, it seems that at *t* Tom both does and does not weigh merely *n* pounds. Similarly, if Tom changed his parts prior to time-travelling (presumably, by at least gaining some new ones), we might say Tom is made of just the *x*s and is not made of just the *x*s. But if we relativise weight and parthood properties (as well as any other properties with respect to which an entity might vary across different regions at which it is located), we can avoid violations of Leibniz's Law.

But will indexing parthood help with the problem we've raised for the Transitivity of Proper Parthood? Suppose that we index parthood to only one region. What will the new principle amount to? Hudson offers:

- ***Transitivity of Proper Parthood 1*:** Necessarily, for any objects, *x*, *y*, and *z*, and region, *r*, if *x* has *y* as a proper part at *r*, and *y* has *z* as a proper part at *r*, then *x* has z as a proper part at *r*.[18]

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[15] One might ask: why index the property to the region the second relatum is wholly located at? Why not try something else, like "any region whatsoever" (suggested by Hud Hudson in conversation)? My worries about this are like my worries about dropping the 4th place in the relation altogether. While it may work for some principles, it won't work for all of them, and so a theory using the "any region whatsoever" index would at best use it for some principles and not others, and would seem gerrymandered. For instance, it fails with the *Asymmetry of Proper-Parthood*, which would be: For any objects, *x* and *y*, and regions *r* and *r'*, if if *x* is at *r* a proper part at *r'* of y, then it's not the case that there exists a region, *r'*, such that *y* is at *r'* a proper part at *r* of *x*. This fails for the reasons formulation (1) of the principle fails below.

[16] The problem of temporary intrinsics was presented in Lewis 1986, 202-205, and arguably dates back to Heraclitus. The generalised problem is discussed in Hudson 2006, 108-111, and in McDaniel 2003.

[17] Note: here and throughout this paper, I use 'property' in a broad sense to include both properties and relations. (This is due to thinking of relations as *n*-place properties where $n > 1$.)

[18] 2001 66. On p. 68 Hudson offers a stronger account, but that account is in conflict with my case for much the same reason as the principle formulated in the main text.

Unfortunately, this will not help in our Clifford/Odie case. Because we're relativising to only one region within the entire principle, and that region must be a subregion of the region at which *y* is wholly located (because it's the region we're relativising the parthood relation between *x* and *y* to, where *y* is the whole), and it must be a superregion of the region at which *y* is wholly located (because it's the region we're relativising the parthood relation between *y* and *z* to, where *y* is the part), then the region we relativise to must be the region at which *y* is wholly located. However, applying that to our case: Clifford (occupying the small region) is a proper part of Kibble at the region at which Kibble is wholly located, and Kibble is a proper part of Clifford (occupying the big region) at the region at which Kibble is wholly located. It should follow, then, that Clifford is a proper part of Clifford at that region. But regardless of which region you relativise to, an entity cannot be a proper part of itself.

We could instead relativise parthood to a single region, namely the salient region at which the part is located, and produce this principle:

- ***Transitivity of Proper Parthood 1**:*** Necessarily, for any objects, *x*, *y*, and *z*, and regions, *r1* and *r2*, if *x* has *y* as a proper part at *r1*, and *y* has *z* as a proper part at *r2*, then *x* has z as a proper part at *r1*.

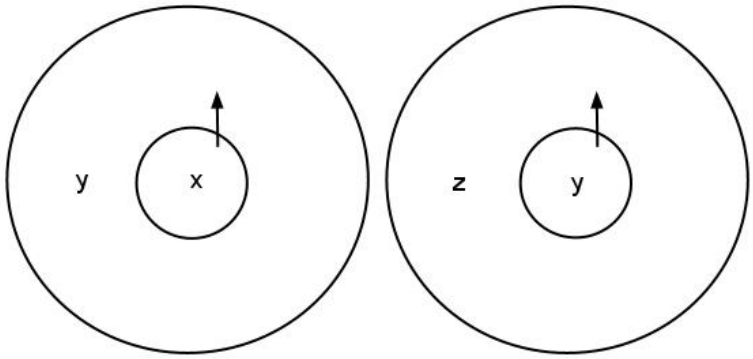
Similarly, we can relativise parthood to a single region, namely the salient region at which the whole is located, and produce this principle:

- ***Transitivity of Proper Parthood 1***:*** Necessarily, for any objects, *x*, *y*, and *z*, and regions, *r1* and *r2*, if *x* has *y* as a proper part at *r1*, and *y* has *z* as a proper part at *r2*, then *x* has z as a proper part at *r2*.

Unfortunately, both of these principles are incompatible with my Clifford/Odie case; taking them in turn, (a) Clifford at the small region is a proper part of Kibble, and Kibble at the medium region is a proper part of Clifford, so by Transitivity of Proper Parthood 1*, Clifford at the small region should be a proper part of Clifford; and (b) Clifford is a proper part of Kibble at the medium region, which is a proper part of Clifford at the large region, so by Transitivity of Proper Parthood 1**, Clifford should be a proper part of Clifford at the large region. But again, regardless of which regions we relativise to, an entity can never be a proper part of itself.

Further, these two Transitivity principles are far too restrictive. They both give the wrong result in this case: suppose that *x* at R1 is simple, and part of *y* which is

located at both R2 (which has R1 as a subregion), and R3 (which is point-sized and does not have R1 as a subregion. *y* at R3 is simple, but is part of *z* which is located at R4 (which has R3 as a subregion and is disjoint from R2).



Both of the Transitivity principles would entail, in this case, that *x* must be (relative to some region) a part of *z*. But intuitively this is clearly mistaken.

Are things any better when we index parthood to two regions? The Transitivity of Proper Parthood becomes:

- ***Transitivity of Proper-Parthood 2:*** Necessarily, for any objects, *x*, *y* and *z*, and regions *r1*, *r2* and *r3*, if x is wholly located at *r1*, *y* is wholly located at *r2*, and *z* is wholly located at *r3*, and *x* at *r1* is a proper part of *y* at *r2* and *y* at *r2* is a proper part of *z* at *r3*, then *x* at *r1* is a proper part of *z* at *r3*.

Unfortunately, this also does not help. Our case is one in which Clifford at the small region is a proper part of Kibble at the medium region, and Kibble at the medium region is a proper part of Clifford at the large region. According to the above axiom, it follows that Clifford at the small region is a proper part of Clifford at the large region. But again, this would require Clifford to be distinct from himself.

So if we accept the possibility of the Clifford/Odie case, the necessary truth of the Transitivity of Proper Parthood seems to be forfeit. However, we might question whether this is such a bad consequence. Perhaps what we found so compelling about the transitivity of proper parthood can be captured by the transitivity of *parthood*, which is still available to us.[19]

[19] The transitivity of parthood has come under attack in the literature. Achille Varzi (2006) quotes N. Rescher (1955): "In military usage, for example, persons can be parts of small units, and small units parts of larger ones; but persons are never parts of large units." However, I find Varzi's response compelling:

However, Nikk Effingham (2010) presents a (relevantly dissimilar) time-travel case to raise problems for the Transitivity of Parthood as well as for the Transitivity of Proper Parthood. In his case, there is a car that has a proper part, a wheel, which goes on to become separated from the car and gain an extra part. The wheel then time-travels back, becoming multilocated: in one region, it's part of the car, and in another it is not but has the extra, small part. So (with no indexing of parthood), the small part is a proper part of the wheel, which is a proper part of the car, even though the small part is never part of the car (let alone a proper part of the car). This case conflicts with both Transitivity of Proper Parthood and Transitivity of Parthood. However, unlike in the Clifford/Odie case, the worries the car case raises for both kinds of Transitivity dissolve as soon as we relativize parthood to regions (be it to one or to two). If, however, we forgo any relativization to regions (or a similar response involving appeal to constitution), Effingham's case will be particularly problematic and the solution of settling for the Transitivity of Parthood will not be available.

4. Asymmetry of Proper Parthood

Our Clifford/Odie case also violates the Asymmetry of Proper Parthood, according to which, necessarily, if something is a proper part of something else, then that second thing isn't a proper part of the first. In our case, Clifford is a proper part of Kibble, which is a proper part of Clifford.[20]

Indexing parthood to a single region does not help us. The principle becomes:

- ***Asymmetry of Proper-Parthood 1*:** Necessarily, for any objects, *x* and *y*, and region *r*, if *x* is a proper part of *y* at *r*, then it's not the case that *y* is a proper part of *x* at *r*.

I see five reasonable contenders for how we might read this.

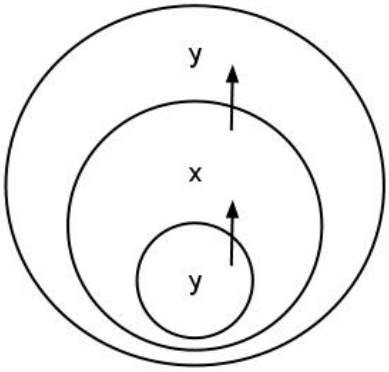
Rescher's worry seems to stem from the usage of 'part' to denote something more than simply an entity standing in the parthood relation to a whole. (For more on this, see Johansson 2004 and Varzi 2006.)

[20] Nikk Effingham (2010) has presented a case he believes to be in conflict with the Asymmetry of Proper Parthood, but which I find completely compatible with (even the non-relativized version of) the principle. In his case, an object shrinks and time-travels back to become part of itself. Perhaps because it is smaller, he says that the little object is a proper part of the big one. Presumably he uses substitution to get the contradiction with Asymmetry of Proper Parthood. But I disagree with his description of the case: the little object is not a *proper* part of the big one, because the two objects are identical! At most we can say it is a part of itself, but this is unproblematic.

- ***Singly-Indexed Asymmetry Reading 1*:** Necessarily, for any objects, *x* and *y*, and region *r*, if *x* at *r* is a proper part of *y*, then it's not the case that *y* is a proper part of *x* at *r*.

That is, we're taking the principle to tell us that if some object, *x*, is located at a region, *r*, and is, at that region, a part of some other object, *y*, then it's not the case that *x* at that region also has *y* as a part. (So we're taking *r* to be the location of the proper part in the antecedent, and we're using that same region in the consequent.)[21]

Unfortunately, Reading 1 is incompatible with the possibility of our Clifford case. In it, Kibble, at the medium region, is a part of Clifford, and also has Clifford as a part at that region. I.e., it's an instance of what's depicted here:



There are alternative ways of attempting to read the singly-indexed version of the Asymmetry of Proper Parthood. For instance:

- ***Singly-Indexed Asymmetry Reading 2*:** Necessarily, for any objects, *x* and *y*, and regions, *r1* and *r2*, if *x* at *r1* is a proper part of *y*, then it's not the case that *y* at *r2* is a proper part of *x*.

For this reading, we are relativising every instance of proper parthood to the region at which the proper part is located. (I intend my saying "*x* at *r1* is a proper part of *y*", rather than, say, "*x* is a proper part of *y* at *r1*" or "*x* is a proper part at *r1* of *y*" to indicate that I intend to relativise parthood to *x*'s location rather than *y*'s location or some other region.) However, it's not clear yet how we ought to interpret this reading. When we talk of *y* at *r2* in the consequent, are there any restrictions on which regions we can identify with *r2*, beyond being a location of *y*? I see two plausible answers, neither of which work.

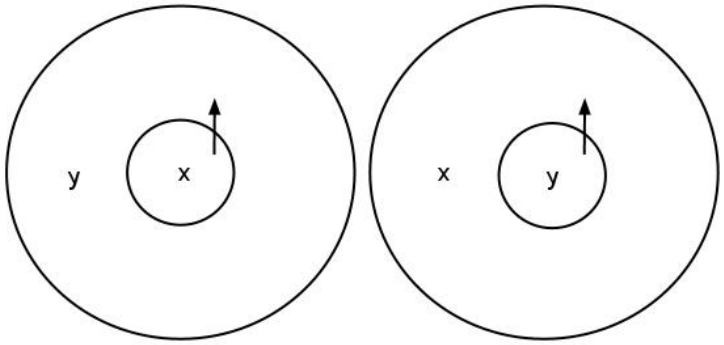
[21] Equivalently, we can say: Necessarily, for any objects, *x* and *y*, and region *r*, if *y* is a proper part of *x* at *r*, then it's not the case that *x* at *r* is a proper part of *y*. This is the reading we get when we take *r* to be the location of the whole in the antecedent, and use the same region in the consequent.

First, one might claim that there are no further restrictions. But the resulting principle is too restrictive. First, it is still incompatible with the possibility of the Clifford/Odie case; since Kibble at the medium region is a proper part of Clifford, then according to the principle, there cannot be any region at which Clifford is located and is a proper part of Kibble.

Further, the principle will rule out a case like this one:

- *Disjoint Multilocation:* Each of two objects, *x* and *y*, is multilocated, and each location of each object is disjoint from the other locations of that object, and at one region *x* has *y* as a proper part, and at the other *x* is a proper part of *y*.

That is:



Call the little region *x* is located at within *y* 'R1'. And call the little region *y* is located at within *x* 'R2'. *x* at R1 is a part of *y*, in the above case. Our principle, under the current reading, says there cannot be *any* region that is occupied by *y* where *y* is a part of *x*. But we have such a region: R2 has those features.

One way to respond to these worries is to place some restrictions on which locations of *y* we can identify with *r2* in our Singly-Indexed Asymmetry Reading 2. We could, for instance, say that we'll restrict ourselves to regions *y* is located at where *x* at *r1* is a part of *y*. That is: according to our principle, necessarily, for any objects, *x* and *y*, and region, *r1*, if *x* at *r1* is a proper part of *y*, then it's not the case that there is some *r2* such that y at *r2* is a proper part of *x*, and *r1* is a subregion of *r2*.[22]

[22] This formulation does not quite get us the restriction that *x* is at *r1* a part of *y* at *r2*. But in order to get this, we would have to relativise parthood to the region at which the whole was located (perhaps in addition to relativising parthood to the region at which the part is located). And even if we are willing to pay this cost to get the restriction exactly as we want it, it will not help us avoid the worry I raise.

This will help us avoid incompatibility with the Disjoint Multilocation case. The only region at which *y* is a part of *x* is one which does not have a location of *x* as a subregion. (Similarly for *x*: the only location at which *x* is a part of *y* is one which does not have a location of *y* as a subregion.) Unfortunately, the revised principle is still incompatible with the Clifford/Odie case. The region at which Kibble is a part of Clifford does, in fact, have a location of Clifford as a subregion. And Clifford at that smaller region is a part of Kibble.

There is a third reading that runs into the same troubles:

- ***Singly-Indexed Asymmetry Reading 3*:** Necessarily, for any objects, *x* and *y*, and regions, *r1* and *r2*, if *x* is a proper part of *y* at *r1*, then it's not the case that *y* is a proper part of *x* at *r2*.

Whereas with Reading 2 we relativised every instance of proper parthood to the region at which the proper part was located, here we're relativising every instance of proper parthood to the region at which the whole is wholly located. However, as before, it's not clear how we ought to interpret this reading. When we talk of *x* at *r2* in the consequent, are we placing any restrictions on which regions we can identify with *r2*, beyond being a location of *x*? Once again, there are two reasonable answers, neither of which helps us.

First, we can say that there are no restrictions. But then our case will be incompatible both with the Clifford/Odie case, and with the Disjoint Multilocation case. Consider the Disjoint Multilocation case: call the big region *y* is located at 'R3', and the big region *x* is located at 'R4'. *x* is a proper part of *y* at R3. So on our current reading, our principle tells us that there can't be any region at which *x* is both located and in possession of *y* as a proper part. But we have exactly such a region: R4.

As before, we could place restrictions on which locations of *x* we are concerned with; we want to only worry about the regions *x* is located at where it is a proper part of *y* at *r1*. That is: according to our principle, necessarily, for any objects, *x* and *y*, and region, *r1*, if *x* is a proper part of *y* at *r1*, then it's not the case that there is some *r2* such that *y* at is a proper part of *x* at *r2*, and *r1* is a superregion of *r2*.[23]

[23] As before, this doesn't entail quite the restriction we want, but even with the restriction as originally characterised, the principle will be incompatible with the Clifford/Odie case.

Unfortunately, as before, the principle with the extra restrictions is still incompatible with the Clifford/Odie case. In it, Kibble is a proper part of Clifford at the big region. The principle tells us that there cannot be any region such that (i) Kibble is located there, (ii) Clifford is a proper part of Kibble at that region, and (iii) the big region is a superregion of this region. However, we have exactly such a region: the medium region at which Kibble is located! Clifford (at the little region) is a proper part of Kibble at the medium region, and the big region is a superregion of that region.

There are two final readings we might appeal to.

- ***Singly-Indexed Asymmetry Reading 4*:** Necessarily, for any objects, *x* and *y*, and region, *r1*, if *x* at *r1* is a proper part of *y*, then it's not the case that *y* at *r1* is a proper part of *x*.

- ***Singly-Indexed Asymmetry Reading 5*:** Necessarily, for any objects, *x* and *y*, and region, *r1*, if *x* is a proper part of *y* at *r1*, then it's not the case that *y* is a proper part of *x* at *r1*.

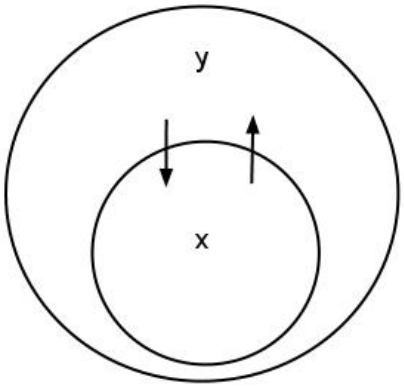
In reading 4, we are relativising proper parthood to the region at which the part is located, and in the consequent we appeal to *the very region* that was invoked in the antecedent. In reading 5, we are relativising proper parthood to the region at which the whole is located, and in the consequent we appeal to *the very region* that was invoked in the antecedent.

These principles rule out traditional violations of asymmetry, where two entities are coincident and are proper parts of one another, as in statue/lump examples. Further, the principles are compatible with the Clifford/Odie case. For instance, going with reading 4 and relativising proper parthood to the regions at which the proper parts are located: Clifford at the small region is a proper part of Kibble (at the medium region), but it is not the case that Kibble at the small region is part of anything, because Kibble doesn't occupy the small region. And Kibble at the medium region is a proper part of Clifford (at the big region), but it's not the case that Clifford at the medium region is part of anything, because Clifford does not occupy that region. Similarly, going with reading 5 and relativising proper parthood to where the whole is wholly located: Kibble is a proper part of Clifford at the big region, but it's not the case that Kibble at the big region has anything as a proper part, because Kibble doesn't occupy that region. And Clifford is a proper part of Kibble at the medium region, but it's not the case that Clifford at the medium region has anything as a proper part, because Clifford does not occupy that

region. The lack of colocation in the Clifford/Odie case guarantees compatibility with our principles.

Unfortunately, each of these principles is both too restrictive and too liberal. They are too restrictive because they fail to rule out cases like this one:

- *Colocation-Free Asymmetry Violation:* Neither x nor y is multilocated. *x* is located at *r1*, which is a proper subregion of *r2*, where *y* is located. *x* is a part of *y*, and *y* is a part of *x*. (It follows from what I've said that *x* and *y* are distinct.)

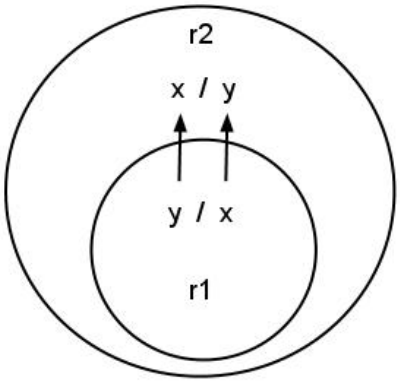


Of course, this is a very odd case: a proper part of *x* is located partly outside of the one and only region *x* occupies. We may think that this alone is grounds for rejecting the possibility (and even conceivability) of the case. It think that this is *one* good reason for rejecting the case's possibility, but another is that there's a violation of what our intuitions supporting the Asymmetry of Proper Parthood are latching on to. Insofar as our revised Asymmetry of Proper Parthood captures those intuitions, it should be able to rule out the case all on its own. And neither of our principles do rule out this case: reading 4 tells us only that if *x* at *r1* is a proper part of *y*, then it can't be that *y* is also located at *r1* and is at that region a proper part of *x*. Since *x* and *y* are not coincident in my case, it automatically satisfies the principle. Similarly for reading 5, which tells us only that if *x* is a proper part of *y* at *r1*, then it's not the case that *x* is also located at *r1* and *y* is a proper part of *x* at that region. However, for those who are not yet convinced of the inadequacy of the principles, there are additional worries.

If we think that entities can be both colocated and multilocated, we'll run into trouble with these principles: they will be too restrictive. Imagine this case:

- *A Strange Coincidence:* *x* at *r1* is a small bronze statue, which is part of a golden statue, *y* at *r2*. Over time, the golden statue shrinks significantly, while the bronze statue slowly has parts added to it. After a while, *y* becomes a part of the bronze

statue (say, an ornament on its head). Then our statues time-travel, and colocate: *x* wholly occupies *r2*, and *y* wholly occupies *r1*.



In this case, if we're relativising proper parthood to the region at which the part is wholly located, *x* is at *r1* a proper part of *y*, and *y* is at *r1* a proper part of *x*. And if we are relativising proper parthood to the region at which the whole is wholly located, we'd say: *x* is a proper part of *y* at *r2*, and *y* is a proper part of *x* at *r2*. Both of these are incompatible with the Asymmetry principle above, but this case does not seem to violate the intuitions behind the Asymmetry of Proper Parthood in any problematic way. (Though we may find the colocation problematic, that at least seems conceivable. Further, even if colocation is impossible, we wouldn't want *that* to be what it is in virtue of that proper parthood is asymmetrical.)

Fortunately, we get a better result when parthood is indexed to two regions. The relativised axiom is:

- ***Asymmetry of Proper-Parthood 2*:** Necessarily, for all objects, *x* and *y*, and any regions *r1* and *r2*, if *x* at *r1* is a proper part of *y* at *r2*, then it's not the case that *y* at *r2* is a proper part of *x* at *r1*.[24]

This principle is compatible with the Clifford/Odie case: though Clifford at the small region is a proper part of Kibble at the medium region, it is not the case that Kibble at the

[24] There are other doubly-indexed principles of asymmetry of proper parthood that also work:

(i) Necessarily, for any objects, *x* and *y*, and regions, *r1* and *r2*, if *x* is at *r1* a proper part of *y* at *r*2 , then it's not the case that *x* at *r2* is a proper part of *y* at *r1*.

And:

(ii) Necessarily, for any objects, *x* and *y*, and regions, *r1* and *r2*, if *x* is at *r1* a proper part of *y* at *r2*, then it's not the case that *y* at *r2* is a proper part of *x* at *r1*, or that *x* at *r2* is a proper part of *y* at *r1*.

Regardless of which of these forms we choose, the Asymmetry of Proper Parthood 2 is compatible with the Clifford/Odie case.

Note, however, that all three of these formulations will be incompatible with a case just like the Strange Coincidence, except that *r1* = *r2*.

medium region is a proper part of Clifford at the small region. Instead, Kibble at the medium region is a proper part of Clifford at the large region. And the principle also gives the right result in the colocation case: though *x* at *r1* is a proper part of *y* at *r2*, and *y* at *r2* is a proper part of *x* at *r1*, it's not the case that *y* at *r2* is a proper part of *x* at *r1*, nor that *x* at *r2* is a proper part of *y* at *r1*.

5. Metaphysics In The Bathtub

Consider now two final ways of being multilocated.

- **Claim 2:** It is possible that there exist an object, *x*, and regions *r1*, *r2* and *r3*, such that *r1* and *r2* are distinct, *r3* is the fusion of *r1* and *r2*, and *x* is exactly located at each of *r1*, *r2* and *r3*.

That is, an object can multilocate and also occupy the fusion of all the regions it is located at.

- **Claim 3:** It is possible that there exist some objects, *x* and *y*, and regions *r1*, *r2* and *r3*, such that *x* and *y* are distinct, *r1* and *r2* are distinct, *r3* is the fusion of *r1* and *r2*, *x* is exactly located at each of *r1* and *r2*, and *y* is exactly located at *r3* and fuses *x* at *r1* and *x* at *r2*.

This kind of multilocation is like the last one, except that the object at the fusion of all the regions is distinct from the multilocated object, and it is the fusion of the multilocated object at various regions. The kind of multilocation presented in Claim 3 will raise troubles for Weak Supplementation.[25]

A case supporting Claim 3 has been presented in the recent literature by Cody Gilmore. He says:

> Suppose that some cell is originally created at the beginning of the year 2000 and that it jumps back in time over and over again, never venturing further back in time than the moment of its original creation, and never progressing beyond the year 2002. The cell's entire career is confined to this three-year interval. Suppose also that the cell never leaves the vicinity of my bathtub. If this cell's trips were structured properly, if it made enough of them, and if it underwent the

[25] Another kind of multilocation that will raise similar difficulties:

- **Claim 4:** It is possible that there exist some objects, *x, y*, and *z*, and regions *r1*, *r2* and *r3*, such that *x* and *z* are distinct, *r1* and *r2* are disjoint, *r3* is the fusion of *r1* and *r2*, *x* is exactly located at *r1*, *y* is wholly located at a subregion of *r1* and also at *r2*, and *z* is wholly located at *r3*. *y* is at the subregion of *r1* a proper part of *x* at *r1*, and *z* at *r3* fuses *x* at *r1* and *y* at *r2*.

> right sorts of intrinsic changes along the way, the cell might compose some macroscopic object that sits in my bathtub for three years.[26]

Gilmore says the cell has many different spatial regions it wholly occupies at each instant, whereas the macroscopic object is only exactly located at one region per instant. He says that this (among other things) shows the cell and the macroscopic object to be distinct. If he is right about this, then this is a case where an object is the fusion of a distinct object at one region, and that same object at some other regions.

Gilmore presents another case later in the paper, where a single atom is multilocated, and thus seems to compose a molecule. In both of these cases, an object, via being wholly present at multiple spatial regions at a single time, seems to compose a larger object at that time. Further, Gilmore argues, these larger objects are distinct from the multilocating ones. (An important thing to note, as Gilmore does here, and Eagle (2010) also points out: if we think it's possible for, e.g., an atom to time-travel to compose a molecule, and we think the atom and the molecule are distinct, then endorsing what I've called *Bloat Theory* will require the possibility of colocation. The molecule and atom will be coincident. This is another reason for us to posit the possibility of multilocation, insofar as we posit the possibility of time-travel, this sort of composition, and want to avoid the possibility of colocation.[27])

However, it is far from clear to me that we must claim these kinds of objects will always be distinct; I suspect our intuitions about it will depend on the particulars of the cases. But at least sometimes, our intuitions push decisively in favour of distinctness.[28]

Independently of issues about distinctness of the entities involved, there is another piece of motivation for thinking that it is possible to have a fusion of a multilocated object, where the fusion is located at the fusion of the regions the multilocated object occupies. Suppose that *x* is multilocated and composite. Further, suppose that a multilocated object can not only vary in its parts across regions at which it's wholly located, but that it can have a completely different set of parts composing it at one region than it has at another. (E.g., we can imagine time-travelling Tom being composed of a completely different group of cells than he used to be.) If we suppose these things and

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[26] 2007, 180.
[27] Eagle responds by saying we do not have adequate motivation for believing the cell and the bathtub man to be distinct.
[28] For a case of this sort, see the Clayto/Sitz example in Kleinschmidt 2011.

also accept something like Universalism (or we construct the case so that it involves objects that even one who restricts composition would want to admit a fusion of), then there is an object that is the fusion of all of the members of the union of the two sets of parts the multilocated object has. This fusion would be wholly located at the fusion of the regions at which *x* is wholly located. And as far as I can tell, it is up in the air whether this fusion is identical to the multilocated object or not.[29]

6. Weak Supplementation

In the literature[30], it has been noted that cases like Gilmore's Bathtub Man example conflict with the axiom of Weak Supplementation. Weak Supplementation says that, necessarily, for all *x* and *y*, if *y* is a proper part of *x*, then there exists a *z* such that *z* is a proper part of *x* and *z* is disjoint from *y*.

Consider Gilmore's multilocation-made molecule (i.e., the case involving the atom that seems to compose a molecule via being multilocated). This case will violate Weak Supplementation because in it, the molecule is wholly decomposable into a single (multilocated) atom. It's a fusion of the atom on the right and the (same) atom on the left. The atom on the right is a proper part of the molecule, and so Weak Supplementation requires that there's a part of the molecule that doesn't share a part with the atom. But because the molecule is wholly decomposable into the atom, every part the molecule has must share a part with the atom. (This follows from the plausible general principle that any time an object, *z*, is wholly decomposable into the *w*s, any part of *z* must mereologically overlap with one of the *w*s.) And it does: for instance, any electrons on the left are parts of the atom.

Intuitively, though, this case needn't be problematic due to supplementation worries. Suppose that the atom changes its parts before it time-travels back to multilocate. Then we have a decomposition of the molecule into parts that really don't overlap one another, even though the parts on the left fuse to make the same object that the parts on the right do.

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[29] It is worth keeping in mind that if we accept Claim 3 due to some general principle (such as: whenever *x* is wholly located at *r* and at *r'*, *x* is wholly located at the fusion of those regions), we may get counterintuitive results in some cases. For instance, following the general principle just stated, we won't be able to say what we may want to about the shape and weight of composites in time travel cases.

[30] Effingham and Robson, 2007.

I shall now discuss two problems that these considerations draw our attention to. First, there are some cases (involving non-multilocated wholes and multilocated parts), like the one just mentioned, which violate Weak Supplementation (and an analogous principle with parthood indexed to the region the whole is located at) without being in contradiction with the intuitions behind Weak Supplementation. Second, there are some cases (involving multilocated wholes) that do not violate Weak Supplementation (or *any* of the analogous principles we can provide using indexing of parthood) even though they are in contradiction with the intuitions that support the principle. These considerations, I believe, show that the spirit of Weak Supplementation is incompatible with the possibility (or perhaps even conceivability) of the kind of multilocation claim 3 describes.

For the first problem: When a (non-multilocated) object satisfies claim 3, it will violate Weak Supplementation. According to claim 3, it is possible for there to be an object, *y*, which is the fusion of another object, *x*, at one region and that same object (i.e., *x* again) at a distinct region. If *x* is a proper part of *y,* then *y* must have another proper part that is disjoint from *x*. But because *y* is wholly decomposable into *x* at *r1* and *x* at *r2*, all of *y*'s parts will mereologically overlap with *x*; this follows from the general principle that any time an object, *z*, is wholly decomposable into the *w*s, any part of *z* must mereologically overlap with one of the *w*s. This means that there are some cases where Weak Supplementation will be violated by a case that is not in tension with the intuitions that support Weak Supplementation. For instance, consider again time-travelling Tom, in the scenario where he changes all of his parts prior to time-travel. (Suppoose Tom is made up of a group of cells, the *x*s, at *t1*, then over time undergoes complete replacement of all of his cells, so that when he time-travels back to *t1* he is made up of the *y*s, a group of cells with no members in common with the *x*s.) The fusion of Tom in the living room and Tom in the kitchen is, we can plausibly claim, distinct from Tom; it is wholly decomposable into a bunch of atoms, none of which are multilocated. Further, it occupies a region twice as large as the region Tom is located at. In this case, though Tom in the kitchen is part of the fusion, there are a bunch of parts the fusion has (namely, the atoms composing Tom in the living room) which, intuitively, don't overlap in a problematic way with Tom in the kitchen.

We could attempt to index parthood to get a version of Weak Supplementation that this case is compatible with. For instance, if we're indexing parthood to a single region (the region at which the whole is located), we get:

- ***Weak Supplementation 1*:** Necessarily, for any objects, *x* and *y*, and region *r*, if *y* is a proper part of *x* at *r*, then there exists a *z* such that *z* is a proper part of *x* at *r* and *z* is disjoint from *y* at *r*.

For this formulation I depended on Hudson's definitions of disjointness and overlap:

- '*x* is disjoint from *y* at *r*' =*df* it is not the case that *x* overlaps *y* at *r*.
- *'x* overlaps *y* at *r*' =*df* there is an object, *z*, such that (i) *x* has *z* as a part at *r*, and (ii) *y* has *z* as a part at *r*.[31]

Unfortunately, this revised principle is still incompatible with a non-multilocated object satisfying claim 3. Consider the fusion that is wholly decomposable into Tom in the living room and Tom in the kitchen and which is located at the fusion of those regions, *r*. Consider one of the atoms that is part of Tom in the kitchen. The fusion has, at *r*, both the atom and Tom in the kitchen as parts. But Tom and the atom will overlap at *r*. Though the atom is not a part of Tom in the living room, it is a part of Tom in the kitchen, and therefore shares a part with Tom (namely, itself) at *r* (since *r* has the kitchen-location as a subregion).

We may attempt to get around this by indexing to a different region: we might index to the regions at which the parts are located. That principle would be:

- ***Weak Supplementation1**:** Necessarily, for any objects, *x* and *y*, and regions *r* and *r'*, if *y* is a proper part of *x* at *r*, then there exists a *z* such that *z* is a proper part of *x* at *r*' and *z* is disjoint from *y* at *r*.

This solves the first problem. However, the second problem applies to this formulation and to the preceding two: too many cases will satisfy them.[32] For instance, suppose I have my original case of *y* at *r* fusing *x* at *r1* and *x* at *r2*. Let *x* at *r1* and *x* at *r2* be simple. Suppose also that *y* is wholly located at *r'*, and there it is wholly decomposable into *z* and *w* (both distinct from *x*). This is a problem, because *x* at *r1* is a proper part of *y*, and *z*

[31] 2001 64. It's worth pointing out that on the above definitions, two entities can only overlap at regions their shared parts wholly occupy: the region must be a subregion of both the region *x* wholly occupies, and the region *y* wholly occupies, while having as a subregion the region *z* wholly occupies. But objects can be disjoint at larger regions than this, since disjointness only requires that overlap *not* occur at that region.
[32] This liberalism is noted in Donnelly 2010.

(outside of *r1* and *r2*) is a proper part of *y*, and *x* and *z* certainly don't overlap. But a case in which one object is wholly decomposable into a distinct (multilocated) simple seems to be a clear a counterexample to the intuition behind Weak Supplementation. We shouldn't be interested in making these cases compatible with a formulation of Weak Supplementation, insofar as we want to respect those intuitions.

Sadly, formulating Weak Supplementation with parthood indexed to two regions does not help. It's compatible with our case, but it's also compatible with a case that is in conflict with the intuitions that supported the original axiom of Weak Supplementation. This is a bad thing, since it seems there's something to the intuition. The formulation is:

- ***Weak Supplementation 2*:** Necessarily, for any objects, *x* and *y*, and regions *r1* and *r2*, if *y* at *r2* is a proper part of *x* at *r1*, then there exists a *z* and a *r3* such that *z* at *r3* is a proper part of *x* at *r1* and *z* at *r3* is disjoint from *y* at *r2*.

This can be interpreted using indexed definitions of disjointness and overlap:

- '*x* is at *r1* disjoint at *r2* from *y*' =*df* it is not the case that *x* at *r1* overlaps at *r2 y*.
- *'x* at *r1* overlaps at *r2 y*' =*df* there is an object, *z*, and region, *r3*, such that (i) *z* at *r3* is a part at *r1* of *x*, and (ii) *z* at *r3* is a part at *r2* of *y*.

This formulation is even more straightforwardly too unrestrictive. Consider again the case we just discussed, in which an object, *y*, at *r*, fuses *x* at *r1* and *x* at *r2*, and *x* is simple at each of those regions. In this variant, we don't need *y* to be multilocated. This is enough to cause trouble: intuitively, we simply have one object that is completely decomposable into a single, distinct object. This is contrary to the intuitions supporting Weak Supplementation. But it is compatible with the above formulation of Weak Supplementation 2: *x* at *r1* is a proper part of *y* at *r*, and *x* at *r2* is a proper part of *y* at *r*. It's not the case that there exists an entity, *w*, and a region, *r3*, such that *w* at *r3* is a part of *x* at *r1* and *x* at *r2*. So *x* is at *r1* disjoint at *r2* from *x*. So this case does not violate Weak Supplementation 2. These considerations lead me to believe that we cannot rescue the intuition behind Weak Supplementation in a Mereology that uses location-indexed parthood.

7. Conclusion

I have provided cases which seem possible, or at the very least *conceivable*, in which multilocation occurs in ways that are problematic for the axioms of Minimal Mereology.

I have argued that relativising parthood will not provide us with a way to endorse the possibility (or perhaps even conceivability) of these cases while capturing the intuitions behind the original axioms of Minimal Mereology. Relativising parthood to a single region fails to help us with respect to all three axioms, and relativising parthood to two regions fails to help us with two of them (the Transitivity of Proper Parthood, and Weak Supplementation).

However, offering an alternative, region-based Mereology is not the only way to respond by rejecting Minimal Mereology as standardly understood. One might instead give up on the intuitions that supported it. Maureen Donnelly advocates doing exactly that: she believes that the intuitions in favour of these principles, if they exist at all, were formed upon reflecting on ordinary cases that lack strange things like multilocation or colocation. Once we include such cases in our domain, she claims, we should no longer expect parthood to behave as intuitions say it should in ordinary cases.[33]

Though I do not have a worked-out theory of intuitions and their relation to justification of our philosophical beliefs to offer in response, I do have this thought: as far as I can tell, my intuitions about the nature of proper parthood, at least with respect to things as innocent as asymmetry and transitivity, are as strong and central as my intuitions about just about anything else. If I were to discover that these intuitions could not be trusted, that they were in fact mistaken, I don't know how I would proceed doing Metaphysics. I would no longer feel that I could simply give the dogmatist response when, for instance, someone argues for something like the relativity of identity.

I argue in Kleinschmidt 2011 that we should instead respond to the worries I have raised in this paper by rejecting the possibility (and even conceivability) of multilocation. It is my hope that, rather than undermining our metaphysical knowledge (by showing that we cannot trust our mereological intuitions to provide us with general principles), the cases I have provided help add to it.[34]

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[33] Donnelly 2011.

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