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Multiple location defended

Antony Eagle[1]

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Abstract The notion of multiple location plays an important role in the characterization of endurantism. Several authors have recently offered cases intended to demonstrate the incoherence of multiple location. I argue that these cases do not succeed in making multiple location problematic. Along the way, several crucial issues about multiple location and its use by endurantists are clarified.

Keywords Persistence · Endurance · Multiple location · Extension · Time-travel · Mereology · Recombination principle · Fundamental relations

1 Endurance and multiple location

It is said that an enduring object persists by being wholly present at each moment at which it exists (Sider 2001: 63; van Inwagen 1990). But what is it to be 'wholly present' at a moment? Treating moments of time as spatially maximal but temporally unextended regions of spacetime, a natural initial thought is a mereological one: that x is wholly present at t iff every part of x can be found within t—that is, the whole of it is present during t, and none of it is absent.

When the whole of an object is present at a time, that suffices for the object to have a spatial location at that time. But it isn't necessary that each time at which an object has a spatial location is a time from which none of the object is absent (consider an object that loses parts over time; it will then apparently be partly absent from later times, but will still be located within those times). Faced with this observation, we have a choice: should we say that a persisting object exists at just those times when all of its parts simultaneously exist, giving a mereological

✉ Antony Eagle
antony.eagle@adelaide.edu.au

[1] Department of Philosophy, University of Adelaide, Adelaide, SA 5005, Australia

characterisation of endurance? Or should we say that a persisting object exists at those times at which it is located, no matter which parts it happens to have at those times, and give a locative characterisation of endurance?

While the terminology 'wholly present' pushes us to adopt the former suggestion, it is clear that the possibility of mereologically inconstant objects forecloses a mereological characterisation of endurance (at least one developed using the orthodox two-place parthood relation). The two characterisations will agree on the persistence of mereologically constant things, which may perhaps explain the appearance of mereological vocabulary in the definition of endurance. But the intuitions behind endurance are better captured by a locative characterisation of endurance, such as the one I will now present.

The basic notion is the relation of **exact location**.[1] While officially a primitive, the intended meaning can be glimpsed by means of this sort of gloss:

> an entity x is exactly located at a region y if and only if x has (or has-at-y) exactly the same shape and size as y and stands (or stands-at-y) in all the same spatial or spatiotemporal relations to other entities as does y. (Gilmore, 2013: Sect. 2)

Using this relation, we may offer a non-mereological characterisation of 'wholly present', without any connotation of mereological constancy.

1. x is **wholly present** at t iff x is exactly located at a (proper or improper) subregion of t.

According to this definition, an enduring object must be exactly located within each moment at which it exists. For a non-trivial case of persistence by enduring, where the object exists at more than one time (assuming that distinct times don't overlap), this obviously requires that the exact location relation be one-many. That is, endurance requires that **multiple location** be coherent, as enduring objects are multiply exactly located in time (Balashov 2010; Donnelly 2011; Gilmore 2007, 2013).

[1] This is the relation called '(exact) occupation' by Donnelly (2011: 30) and McDaniel (2007: 132); and called '(exact) location' by Balashov (2010: 16) and Hudson (2005: 98).

Note that it is **not** the relation called 'exact location' by Parsons (2007: 203–5). That relation—let us call it 'P-exact location'—may be defined in the present framework as follows: x is P-exactly located at $R =$ for every region S, S partly overlaps R iff x is exactly located at a region overlapping S. As Parsons notes, it follows from the definition just given that every object has a unique P-exact location; it is crucial to the use I and the other cited authors wish to make of exact location that it is consistent that an object have more than one exact location (Parsons himself is deeply suspicious of the intelligibility of the notion of exact location used by the authors cited above; see Parsons 2008).

That said, Parsons' gloss on (what I've called) P-exact location may be helpful in understanding exact location. He says 'exact location is like [a] shadow in substantival space' (2007: 203). Once we note that if an object is illuminated by multiple light sources, it has multiple shadows, and that these different shadows may have different size and shape to each other despite being the shadows of the very same object, the analogy between an object's shadow in spacetime and its exact location looks close, and the analogy certainly looks more appropriate than any analogy between P-exact location and shadows.

Some philosophers, however, have given arguments to the effect that multiple location is inconsistent with other doctrines widely accepted by endurantists. These arguments obviously threaten to condemn endurance: either it is internally incoherent if it rests on a locative conception of 'wholly present', or hopelessly obscure otherwise (as it would then rest on some yet-to-be-developed mereological account of 'wholly present' which avoids the difficulties noted above).

In the present paper, I wish to consider two prominent objections to multiple location, and show them to be mistaken. This is not yet to defend endurance from other avenues of attack, but at least the threat of incoherence is averted.

2 Barker and Dowe on multiple location

Barker and Dowe (2003) have argued that endurance is incoherent, because multiple location is conceptually incoherent, giving rise to 'paradoxes'. Let O be an enduring entity, multiply located throughout a temporally extended region R by being exactly located within continuum many temporally unextended subregions of R. Then their argument is this:[2]

> At each r that is a sub-region of R, there is an entity… O_r. Take the fusion, or mereological sum, of all such O_rs. Call the fusion $F(O_r)$:
>
> (i) Each such O_r is a 3D entity, since it is located at a 3D sub-region r. O_r is an entity with non-zero spatial extent and zero temporal extent. Each O_r is identical to every other. So each O_r is identical with $F(O_r)$. So, $F(O_r)$ is a 3D entity.
>
> (ii) $F(O_r)$ has parts at every sub-region of R. So it has non-zero spatial and temporal extent. $F(O_r)$ is a 4D entity.
>
> (iii) *Conclusion* $F(O_r)$ is both 3D and 4D, but that is a contradiction since being 3D means having no temporal extent, and being 4D means having temporal extent (Barker and Dowe 2003: 107).

There have been responses to this argument (Beebee and Rush 2003; McDaniel 2003). I think there is a more compelling reply to be made: the argument **equivocates** over the word 'extent', and once we disambiguate, no contradiction follows (I return to McDaniel's response at the end of this section).

Let me introduce some terminology which will help me to substantiate this claim. Beginning with the primitive notion of exact location, let us define two further notions:

[2] The Barker and Dowe argument is explicitly formulated as a problem for endurantist multiple location. But it is easy to generalize their objection to spatial multiple location. Consider a multiply located object which is exactly located at continuum many 2D spatial regions, and which manages to 'fill up' a 3D spatial region by being multiply located at a single time. This object would be both spatially 2D and spatially 3D, by the obvious adaptation of Barker and Dowe's reasoning. My response below applies equally to this mooted generalization.

2. x is **contained in** R iff x is exactly located at a (proper or improper) subregion of R.[3]
3. x is **confined to** R iff every region R' in which x is exactly located is a subregion of R.

Obviously if x is confined to R, all of its exact locations are subregions of R, so it is contained in R. But the converse does not hold. An enduring object, multiply located in time, is contained in each time at which it exists. But if it exists for more than an instant, it is not confined to any time at which it exists. It is, however, confined to that region which is the fusion of all times at which it exists. In general, the conceptual possibility that exact location is many-one opens up a conceptual distinction between containment and confinement.

A region of spacetime is **extended** if it has proper subregions. How can we generalise this notion so that it applies to objects? The following platitude guides us:

4. An object is extended iff it is not wholly within an unextended region.

With both confinement and containment in mind as prospective glosses on 'wholly within', however, we see that this platitude is ambiguous between these two precise theses:

5. An object is extended iff it is not contained in an unextended region.
6. An object is extended iff it is not confined to an unextended region.

As containment and confinement are distinct concepts, these claims (4) and (5) about extension are inequivalent. Both have good claim to make precise the initial platitude (4), however; it would be unwise to argue that one 'really' captures our ordinary concept at the expense of the other. The ordinary notion, if exhausted by the ambiguous platitude with which we began, simply isn't determinate enough in content for this to be plausible. Because containment and confinement coincide in the absence of multiple location, (5) and (6) are both vindicated in ordinary cases: a singly-located spatially extended object is neither contained in nor confined to an unextended region. This supports the legitimacy of both disambiguations of (4): we don't normally outside of philosophical contexts explicitly consider the prospect of multiply located objects. I propose that, rather than regiment ordinary usage in some implausibly determinate way, we may simply introduce by stipulation two notions of extension that both make precise the ordinary notion:

7. x is **l-extended** iff x is not contained in an unextended region (Accordingly, x is **temporally l-extended** iff x is not contained in any region of zero temporal extent).

[3] Note that this is a generalization of the definition of 'wholly present'; while the latter relation has objects and times as its potential relata, containment has objects and arbitrary regions as its potential relata. But where t is a time, an object is wholly present at t iff it is contained in t).

8. x is **f-extended** iff x is not confined to an unextended region (Accordingly, x is **temporally f-extended** iff x is not confined to a region of zero temporal extent).

Let us apply these distinctions to Barker and Dowe's argument. The considerations offered in sub-argument (i) of the Barker-Dowe argument lead us to conclude that $F(O_r)$ is exactly located at many temporally unextended subregions of R, so is able to be contained in an region of zero temporal extent, so ***is not*** temporally l-extended. Sub-argument (ii) allows us to conclude that $F(O_r)$ has parts throughout a temporally extended region, so cannot be confined to a region of zero temporal extent, and hence ***is*** temporally f-extended. The **unproblematic conclusion** which can be drawn is precisely what we expect for an non-trivially enduring object that persists by multilocating: that $F(O_r)$ is temporally f-extended without being temporally l-extended. Only by failing to distinguish these two notions of extension can the contradictory conclusion be derived.

Because Barker and Dowe elide the conceptual distinction between f- and l-extension—as best I can tell, they simply overlook the distinction between containment and confinement, they characterise the unproblematic conclusion as a paradox. It is entirely legitimate to use the distinction between f- and l-extension to invalidate their argument. Their scenario is supposed to show the incoherence (not just the metaphysical impossibility) of multiple location. Since there is a coherent way of describing their scenario, making use of notions readily defined and distinguished once we accept that exact location is a legitimate primitive, there is no paradox. There is nothing logically or conceptually problematic about multiple location, assuming that exact location is itself coherent.

Someone might still deny that there is any genuine distinction between containment and confinement. But that cannot be a legitimate premise in a non-question-begging argument for the conclusion that multiple location is incoherent. Note also that this discussion has taken place at the level of conceptual possibility; it may be, for all we know, that while the concept of multiple location is coherent, it is nevertheless metaphysically impossible.[4] So this response to Barker and Dowe is only an attempt to rebut an argument that multiple location is conceptually incoherent, not an attempt to demonstrate that it is metaphysically possible (though I canvass such an argument below).

Is there any hope for their argument if the equivocation is exposed and avoided? In a follow-up paper, (Barker and Dowe 2005: 72) state that their 'paradox focuses entirely on [this] sense of temporal extent: the temporal magnitude of the region at which an entity is located'. This strongly suggests that they have in mind l-extension as their notion of extension. If we regiment their argument accordingly, substituting l-extension throughout, the argument no longer equivocates. However, the sub-

[4] This could be so: for example, if perdurance turns out to be the correct account of persistence as a matter of metaphysical necessity, then endurantism might be logically and conceptually coherent, but impossible. If that were to come to pass, endurantism would share a modal status with the hypothesis that water isn't H_2O: conceptually coherent, since the concepts involved are distinct, but impossible, because their referents are identical.

argument in (ii) now looks problematic. It purports to derive the conclusion that $F(O_r)$ has non-zero temporal l-extent, from the claim that it 'has parts at every subregion of R'. That claim does entail that $F(O_r)$ fills an extended region. But it does not follow that it can't be contained in a 3D region. Just because $F(O_r)$ is exactly located at each temporally unextended part of R doesn't entail that it is l-extended. A parallel difficulty would afflict the attempt to disequivocate their argument by treating it as concerning f-extension throughout: the argument in (i) does not support the contention that $F(O_r)$ is not f-extended.

A further definition will help us connect this discussion to the existing literature.

9. x **fills** R iff each subregion of R overlaps an exact location of x

It follows that an object which is f-extended fills an extended region[5] (Hence the choice of terminology). In light of this, we can see that more or less the same distinction that I drew above is employed by McDaniel in his characterization of a multi-locater as 'extended in virtue of covering [i.e., filling] an extended region' (McDaniel 2007: 134), while still being small enough to fit wholly within an unextended region (so not l-extended). This conception of f-extended and l-unextended objects—exactly located at many unextended regions, but managing to fill up an extended region—appears elsewhere in the literature, though under different names (Sider 2007: 52; Zimmerman 2002: 402). While Parsons' framework uses a different primitive from ours (as noted earlier), his notion of an **entending** object, 'filling space by being wholly located in each of several places' (Parsons 2000: 404) is functionally very like an f-extended but not l-extended object, as a purely spatial analogue of an enduring object. In the present framework, we may define the general notion of spatiotemporal entension as follows[6]:

10. x **entends** iff there exists some region of spacetime R such that (i) x fills R and (ii) for any region R', x is exactly located at R' only if R' is a proper subregion of R.

An object which endures is then a special case of entending in which the region R filled by the object is temporally extended, and the exact locations of the object are temporally unextended subregions of R.

In some ways, this treatment of extension for multiply located objects chimes with previous observations in the literature on endurance. For example, van Inwagen says of an enduring object in an analogous puzzle case that it

> not have a unique temporal extent… the concept of temporal extent does not apply … to any other object that persists or endures or exhibits identity across time. (van Inwagen 1990: 252)

[5] Suppose that x is f-extended. Since x isn't confined to an unextended region, the region F which is the fusion of x's exact locations must be extended. But the fusion of x's exact locations is such that every subregion of it overlaps an exact location of x, by construction. So x fills F.

[6] Hudson (2005: 99) also adopts Parsons' terminology of 'entending' within a framework taking exact location as primitive, though Hudson's definition has the (unwanted-by-me) consequence that an entending object is mereologically simple.

The preceding discussion makes the grounds for van Inwagen's first claim precise. If 'extended' is ambiguous, there is no unique region the dimension of which settles the question about whether an enduring object is temporally extended. However, that observation doesn't support what van Inwagen goes on to claim. Having made the ambiguity explicit, it is perfectly straightforward to apply the concepts of temporal extent to an enduring object.

The present discussion is reminiscent of some aspects of McDaniel 2003. McDaniel also urges the endurantist to distinguish two ways of being extended—**intrinsically** and **extrinsically**—and to accept that a multiply located object can be temporally extended in one sense and temporally unextended in another, and that this is what occurs in Barker and Dowe's case. This posits a different ambiguity in 'extended' than the one I propose. However, the intrinsic/extrinsic distinction doesn't correctly capture the relevant distinctions. Both f- and l-extension are extrinsic properties of objects. For example, an l-extended object would not be l-extended if spacetime did not exist, which suggests that being l-extended is not intrinsic to objects but is inherited from the way those objects are located in spacetime. But on McDaniel's approach, l-extension is the analogue of his intrinsic extension; he wants to say that an enduring thing is intrinsically unextended. It is theoretically more attractive to take all shape properties, including generalized shape properties like extension, to be extrinsic (McDaniel 2007; Skow 2007). But if we do that, we are forced to say that $F(O_r)$ should count as extrinsically both temporally extended and temporally unextended, giving rise to a contradiction—which is precisely how Barker and Dowe (2005: 71) respond to McDaniel's proposal. The distinction between two sorts of extension is better captured by my proposal than McDaniel's, and Barker and Dowe's response gets no traction against my proposal that *being extrinsically extended* itself admits of disambiguation.

3 Kleinschmidt on multiple location

A more recent challenge to multiple location is this:

> if someone posits the possibility of any one of several kinds of multiple location, he or she will not be able to maintain the necessity of any of the three axioms of Minimal Mereology… For those who take Minimal Mereology to be necessary and universal, that will mean relinquishing the possibility of multiple location. (Kleinschmidt 2011: 253)

Since endurantists generally find it desirable to endorse minimal mereology,[7] and they do defend the possibility of just the kind of multiple location she challenges (being 'wholly located at more than one region'; Kleinschmidt 2011: 255),

[7] **Minimal (extensional) mereology** is the theory comprising the following three axioms (Simons, 1987: 25–31):

(MEM1) Parthood is anti-symmetric and transitive;
(MEM2) If x is a proper part of y, then there is part of y that doesn't overlap x (*Weak Supplementation*); and
(MEM3) If x and y overlap, there is a part of both of which all other parts of both are parts (that is, if there is a common part between two things, there exists a *Maximal Common Part*).

endurantists are among her targets. I will discuss in detail just one of her arguments. The response I will give to this argument can be straightforwardly adapted to her other arguments.

The argument is that a certain scenario involving multiple location is incoherent, and the blame for the incoherence should be assigned to multiple location. The scenario

> 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. (Kleinschmidt 2011: 256)

By the transitivity of proper parthood, the first object will be a proper part of itself, which is incoherent. How can such a case arise? If objects persist by enduring, and **backwards time-travel** is coherent, then there can be conceivable cases in which an object is exactly located at distinct spatial regions at the same time (The involvement of backwards time travel can turn multiple location over time, characteristic of endurance, into multiple location at one time). If the object has the right sort of time-travel trajectory, undergoing the right sorts of changes in size over time, it can be exactly located at spacetime regions r_1 and r_3, such that r_1 is within r_3. Kleinschmidt offers a case intended to illustrate this: the case of Clifford and Odie, where Clifford is a time-traveling statue which shrinks over personal time, travels backwards in external time, and changes its name to 'Odie', and comes to be exactly located at a region within the region which is the exact location of Clifford at the time of Clifford's creation.

The problem arises because Kleinschmidt takes it that Odie is a **proper part** of Clifford; that Clifford at the time of creation has Odie among its parts.[8] Since proper parthood precludes identity, we have a **contradiction**: Odie both is and is not Clifford. The story entails that Odie is distinct from Clifford because a proper part, but is also a story in which Clifford comes to be Odie and hence (by the eternality of identity) is identical to Odie.

The contradiction shows that one of the assumptions behind the scenario Kleinschmidt describes is false. Those assumptions are:

11. Clifford at the time of creation has Odie as a proper part;
12. Odie is a stage of Clifford, later in statue personal time, but simultaneous at the external time of creation;

Footnote 7 continued
Some endurantists, particularly those who allow for coincidence in location between distinct material objects, will not want to endorse minimal mereology; for coincident objects are often take to violate MEM2. I will briefly discuss such views in the following section.

[8] Things are slightly more complicated, because Kleinschmidt sets the case up so that Odie is part of something else ('Kibble'), which in turn is part of Clifford. She's interested in whether the case violates transitivity of proper parthood. Since endurantists should accept the transitivity of proper parthood, the intermediary Kibble isn't essential to the problem posed to the locative conception of endurance by her case.

13. Odie/Clifford persists by enduring, so that Odie's being a 'stage' of Clifford entails that Odie is Clifford, multiply located at the time of creation.

All parties accept assumption (12), that Clifford/Odie is a time-traveller (It would be a mark against endurantism if it could not make sense of backwards time travel). Kleinschmidt, in effect, takes the contradiction to be a *reductio* of (13). But it is more plausible—and not just for endurantists—to regard the scenario as a *reductio* of (11). In the remainder of this section, I will discuss some of the reasons Kleinschmidt does or could offer in favour of (11).

When we look for Kleinschmidt's justification of (11), we see that she begins her story by simply **stipulating** that Clifford has a proper part Odie; then she goes on to tell the story in such a way as to make it clear that Odie **just is** Clifford after undergoing time travel (and certain sorts of survivable intrinsic changes). She thinks this further detail about the identity of the time-traveller Odie shouldn't lead us to revise or reject the initial stipulation:

> 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-traveler shouldn't change the parthood relations we say he stands in at that time… So we ought to claim that Clifford/Odie is a proper part of Kibble, which is a proper part of Clifford. (Kleinschmidt 2011: 257)

This is not correct. Finding out that Odie is a time-traveller might not by itself force us to alter our judgments about the parthood relations it stands in, but of course that is not all we find out. We find out that Odie is Clifford! And that means the original story already involved an impossibility, before anything was said about location, as the story involves Odie being identical to Clifford and being distinct from Clifford. In this respect, the case resembles some other 'paradoxes' of time travel: One cannot assume that stipulations used in setting up a story, even those that would ordinarily succeed, will remain as part of a coherent scenario once all the details of time travel are filled in. I cannot tell the story of Alice, beginning by stipulating that she travels back in time and kills Barbara, and later revealing that Alice **is** Barbara, without ensuring that something in my original stipulations must go awry.

In normal circumstances, of course, Kleinschmidt's stipulations succeed: taking a small dog-shaped statue and adding additional material to make a large dog-shaped statue does result in the first dog-shaped statue coming to be a proper part of the second one.[9] In particular, performing this operation with an intrinsic duplicate of Odie would result in that duplicate being a proper part of the duplicate Clifford. The difference, once again, is that time-travel scenarios often place restrictions on what things can do that are not faced by intrinsic duplicates of those things. Intrinsic duplicate Alice could kill Barbara; Alice cannot. Intrinsic duplicate Odie could be a proper part of Odie; Odie cannot.[10]

[9] Thanks to an anonymous reviewer for pushing this point.

[10] One of the lessons of Lewis (1976) is that in some contexts we can truly ascribe abilities to time travellers based on what their intrinsic duplicates can do. With this in mind, the moral of the main text is more nuanced: in virtue of being a time traveller identical to Clifford, Odie lacks the ability be a proper

In a sense, that is all that needs to be said about Kleinschmidt's example. The example involves an inconsistent time travel scenario, so doesn't provide any basis for an objection to multiple location.

That said, a complete response to Kleinschmidt would explain why this impossible scenario nevertheless seems consistent at first glance. It is thus useful for the endurantists to provide a revised version of the Odie/Clifford scenario, which is genuinely possible, but which shares enough features with Kleinschmidt's original inconsistent case to motivate the suggestion that the *prima facie* possibility of the latter derives from the possibility of the former.

The crucial aspect of the case that must feature in any case that might reasonably be confused with it is this: that Odie ends up 'located within' itself (Kleinschmidt 2011: 257). Can endurantists come up with a consistent variant of the Clifford and Odie example in which Odie is located within Clifford? That will depend on how the word *within* is interpreted. There are at least two interpretations to be considered.

The first is to say that Odie is located *within* Clifford in the same way that air is located within a balloon: by filling an internal cavity.[11] If Clifford has an Odie shaped internal void, it can be exactly filled by Odie, so that Clifford and Odie, at the time of Clifford's creation, have exact locations that jointly cover the region bounded by Clifford's exterior, though without overlapping.

This is clearly a consistent variant of Kleinschmidt's case. It fits with the letter of Kleinschmidt's setup. But it is plausibly confused with her case? I don't believe so. The spirit of her scenario obviously involves a more intimate connection between Odie's location and Clifford's location than jointly filling some region, because the facts about the locations of Odie and Clifford are supposed to give us some reason to think Odie is a proper part of Clifford. There is no inclination to think that the air in a balloon is a proper part of the balloon; x's merely being surrounded by y is no reason to regard x as properly part of y.

To make even a *prima facie* case that Odie is part of Clifford, *within* needs to be given an alternative interpretation. If the location of x is a proper subregion of that of y, then x is within y—as my kidneys are within me, or ganache is within a truffle. To address the apparent plausibility of Kleinschmidt's case, we shall need to examine whether the location of Odie could be a proper subregion of the location of Clifford, while avoiding the inconsistency which arises if Odie is a proper part of Clifford.

Following Sider (2007; see also Saucedo 2011), let us say that x is a **proper contraction** of y iff an exact location of x is a proper subregion of an exact location of y. Using this terminology, our question is whether Odie could properly contract Clifford while not being a proper part of Clifford. If so, there is a consistent **variant** of Kleinschmidt's original case in which Odie/Clifford travels through time and

Footnote 10 continued
part of Clifford. But it is precisely this ability which needs to be truly ascribed to Odie in the context of Klenischmidt's discussion to make the scenario coherent.

[11] Thanks to an anonymous reviewer for pushing me to consider this interpretation.

ends up within itself in a particularly intimate way—intimate enough that it might be confused with the inconsistent scenario Kleinschmidt herself discusses.

In the next section, I'll argue that endurantists should have sympathy for the rather radical idea that Odie properly contracts Clifford. But endurantists need not accept that this entails that Odie is a proper part of Clifford. Working through the details of this argument will also illuminate several independently interesting aspects of the locative conception of endurance (This is the main reason the details of the deeper response are worth exploring).

4 Contraction and coincidence

The variant scenario in which Odie comes to properly contract Clifford would end up equivalent to Kleinschmidt's original inconsistent scenario if this were true:

14. (Necessarily) when x is a proper contraction of y, and x is part of y, then x is a proper part of y (See also Saucedo 2011: 237; Cotnoir 2013: 838).

Certainly Odie is part of Odie, so the contradiction that Odie is a proper part of itself would follow in the variant scenario from (14).

There is certainly *prima facie* plausibility to (14). It also conforms to an attractive picture of the relationship between mereology and location: **mereological harmony**. This is the view that 'mereological relations on material objects each mirror and are mirrored by mereological relations on their exact locations' (Uzquiano 2011). Note that if there is a consistent scenario in which Odie is a proper contraction of itself, so that (14) is false yet *prima facie* plausible, that would explain the intuitive appeal of Kleinschmidt's scenario.

Indeed, there are principled reasons for endurantists to reject (14), and the principle of mereological harmony from which it follows. In this section, I will explore two principled grounds on which endurantists may reject (14). I finish the section by discussing what a consistent scenario involving self-proper-contraction would involve.

Endurantists, because they accept multiple location (i.e., that exact location relation can be one-many), are **dualists about matter and spacetime**. They cannot identify material objects with regions of spacetime, because that would entail that 'is exactly located at' denotes the identity relation, which is one–one. Having accepted that regions and material objects are distinct kinds of things, it would be surprising to go on to insist that, nevertheless, the first kind of thing of necessity shares a mereological structure with the second kind of thing when they stand in the locative relation of exact location.

This surprise can be turned into an argument. For, given dualism, it is very plausible that exact location will be a **fundamental** relation (Saucedo 2011: 271–3). From the fundamentality of location, given the plausible principle that 'any pattern of instantiation of a fundamental relation [is] possible' (Sider 2007: 52), it follows that the exact location relation can be instantiated in such a way as to violate mereological harmony and to violate (14). Beginning with some of material objects,

and some spacetime regions, the fundamentality of location should entail that almost any assignment of objects to regions represents a genuine possibility.[12] So there is an assignment on which Odie is assigned to a dog-shaped region D, and also to a smaller congruent region within D, without impossibility. Then (14) is false.

I can think of a couple of ways to block this argument. (i) Someone might claim that the mereological structure of objects is **inherited** from (or perhaps, **grounded in**) the mereological structure of their exact locations, so that mereological harmony comes out true even under dualism. But there are good reasons to believe that mereological structure is intrinsic (McDaniel 2007: 137). (ii) Perhaps we could take mereological harmony as a **brute necessity**, a restriction on recombination that would support (14), but which is not grounded in 'real definitions plus logic' (Dorr 2008: 53). But accepting such inexplicable restrictions is at least unappealing, as Dorr argues.

Much more can be, and has been, said about the prospects of recombination-based arguments against mereological harmony. Here I want to make two simple points: that endurantists are, by the very nature of their approach to persistence, plausibly committed to the fundamentality of exact location; and that there is an argument from the fundamentality of exact location to the falsehood of (14) that is antecedently attractive to endurantists. It is important to emphasize why these sorts of recombination-based arguments are antecedently attractive to endurantists: they provide a direct route to the **metaphysical possibility**, and not merely the conceptual coherence, of persistence by endurance. If exact location is recombinable, it follows that that it is metaphysically possible that it be instantiated in a one-many pattern over time, which is what endurantists need for non-trivial persistence by multiple location without temporal parts.

Even setting aside arguments from recombination, we may be able to argue directly that endurance already involves violations of (14). Return to Barker and Dowe's object $F(O_r)$. Using the definitions given in Sect. 2, recall these properties of $F(O_r)$: as an f-extended object, it fills R, the fusion of its momentary exact locations r_i; and it is contained in every superregion of each r_i, so is contained in R. However, we did not in Sect. 2 address the question of whether $F(O_r)$ is exactly located at R. Following Gilmore (2007), let us call the temporally extended region fusing the momentary exact locations of an enduring object its **path**. So we are now asking whether an enduring object is exactly located at its path.

It doesn't appear to be generally true that an object is exactly located at any fusion of its exact locations. A spatially bi-located object, exactly located at simultaneous momentary regions r_1 and r_2, is not exactly located at the momentary region which fuses r_1 and r_2, $r_1 \oplus r_2$, because the momentary shape of the object, which it should share with r_1 and r_2, will not generally be the same as the shape of the scattered region $r_1 \oplus r_2$ (Recall the gloss on 'exact location' offered by Gilmore

[12] Those assignments which assign an object to a region R, but assign none of its parts (or parts-as-at-R) to subregions of R, will presumably be illegitimate.

in Sect. 1, where one of the conditions is that objects should share a shape with their exact locations. See also Kleinschmidt 2011: 255; see too Markosian 2004: 671–2).

But the path of an object seems to be a special case. The basic reason is that some geometrical properties of objects correspond to geometrical properties of the path, but to no geometrical property of any momentary exact location. For example, consider properties like **temporal extent**: the duration of an object corresponds to a metrical property of its path but to no metrical property of any of its momentary exact locations. A more compelling example is given by the role that the geometry of an object's path plays in explanations of an object's behavior in relativistic physics.

The endurantist, like other theorists of relativistic persistence, grounds facts about the path of an object in facts about the trajectories of the constituent particles of the object (Sider 2001: 83). But such facts support the association of a 4D Lorentz-invariant path with an enduring object, just as much as with a perduring object. And just as the perdurantist can explain the momentary shapes of a perduring object at given regions by appealing to the shape of the intersection of that region with the path of the object, so too can the endurantist. A nice example of this is in special relativity, where the 4D shape of an object's path provides an explanation of the 3D shapes the object has on each foliation of spacetime. Of course the path of the object can still be reconstructed from the exact locations of the object in any foliation (assuming something like the 'every slice' principle for the locations of enduring things in relativistic spacetime; Gibson and Pooley 2006: Sect. 5). But there is an sense in which the 4D shape of the path is explanatory of the object's 3D shapes in each particular frame of reference, while the converse is not true, and this suggests that the 4D shape is among the shapes of the object (Balashov 2010: 206; Eagle 2011). If endurantists endorse the extrinsicality of shape, as I briefly urged above in Sect. 2, there is no problem with an object having different shapes relative to different regions, as long as we are happy that objects can have 4D shapes alongside their momentary shape properties.

The upshot is this. Enduring objects should be attributed a 4D shape because it may be explanatorily important. The right 4D shape to attribute to an object is the shape of its path. Moreover, enduring objects both fill and are contained in their paths, both of which are necessary conditions on exact location. Given all this, it is plausible to claim that the path of an enduring object is among its exact locations.[13] If it is, (14) will be false. Take $F(O_r)$; it will be located at R, and also at each r_i; and each r_i is a proper subregion of R. But $F(O_r)$ is not a proper part of itself, though it turns out to properly contract itself.

Endurantists should accept that enduring things have 4D shapes; and that having the same shape as a region, filling it, and being contained in it are jointly indicative

[13] Consider again Parsons' framework, discussed in footnote 1. According to Parsons, the path of an object is its only P-exact location. He supports that claim by appealing to a metaphorical account of exact location as being like a geometrical **projection** of the object into substantival space. That metaphor applies at least as well, if not better, to the present notion of exact location; it thus provides intuitive support for taking the path to be among the exact locations of the object, even when the object has other exact locations too.

of being exactly located in the region. Accordingly, there is reason for endurantists to maintain that an object's path is among its exact locations. Accordingly, every case of endurance by multiple location will involve violations of (14). Thus it will not be dialectically effective to try and bolster Kleinschmidt's argument against multiple location by appeal to a principle like (14).

What would a consistent scenario in which something like Odie comes to be a proper contraction of itself be like?

Presumably at least the following must be true. Since Odie is a proper contraction of Odie, Odie must be exactly located at some region *R* which is a proper subregion of another exact location of Odie. There must be some stuff located at that region *R*. The causal history of how that stuff came to be there, and what it is like, must suffice for that stuff to be a time-travelling dog statue, Odie. The present surroundings of that stuff, and what it is like, must suffice for that stuff to be amongst the stuff making up a large dog statue called Clifford, who—it turns out—will go on to become Odie.

There, I think, the uncontroversial things to say about this sort of case cease. The controversial things all stem from the fact that both answers to the following question are controversial: *is there a thing—a particular portion of stuff—which is exactly located at R and which is a proper part of Clifford, so perfectly* ***coincides*** *with Odie*?

The answer 'yes' might be motivated by some thesis such as the Doctrine of Undetached Parts, DAUP (van Inwagen 1981); or there may just be some intuitive pull to saying that there must be something which is the portion of stuff making up Odie. If we say there is such a thing—call it 'Stuff'—, it cannot be identical with Odie, despite exactly sharing a location with Odie, and being made of the same stuff (or being the stuff from which Odie is made). We may introduce, as a placeholder, the term 'constitution' to capture the relationship between these two distinct material occupants of *R*, and say that Stuff constitutes Odie as well as itself, but that Stuff unlike Odie is part of Clifford, so that Stuff constitutes Odie without being identical to it (Fine 2003; Johnston 1992; Thompson 1983).

Whatever else may be said about the relation of constitution, it is difficult to square with extensional mereology. Take for example Thompson's definition of constitution as **mutual parthood**: *x* constitutes *y* at *R* iff *x* is part of *y* at *R* and *y* is part of *x* at *R* (Thompson 1983: 218). Applied to the present case of Odie and Stuff, Odie is part of Stuff; but by the transitivity of parthood, Odie would then be part of Clifford—contradiction. If we adopt Thompson's definition, we must also accept a non-extensional mereology. But even if we retreat from a mereological **definition** of constitution like Thompson's, there will be plausibly be some entailments from constitution to mereological relations (Simons 1987, chs. 5–6). Here is one plausible candidate:

15. If *x* constitutes *y*, then *x* and *y* mereologically overlap the same things.

If (15) is true, and Stuff constitutes Odie, then anything Stuff overlaps Odie does too; since Stuff overlaps itself, Odie overlaps Stuff, and vice versa. But by MEM3, there is a maximal common part of Odie and Stuff, *m*. Since Odie is not part of

Stuff, Odie is not identical to *m*. By MEM2, since Odie is not identical to *m*, there must be a part of Odie which is not part of *m* and which fuses with Stuff to compose Odie. But Odie overlaps that part of itself; so Stuff does too; so it is part of *m*. Contradiction: if we want to retain (15) and constitution, we must abandon some axiom of extensional mereology.

As we wish to retain extensional mereology—remember, the basis of Kleinschmidt's objection is that endurantists cannot, we should not admit that there is any thing which is exactly located at *R* other than Odie, and we should also deny principles like DAUP from which the existence of such things follows (Clifford does fill *R*, but since Clifford also overflows *R* it is not exactly located there).

That there is some portion of Clifford at *R*, which contributes to Clifford's filling *R*, but which doesn't manage to be a particular portion of matter able to be quantified over, is undeniably a strange view. But perhaps it can be made less strange by talking not about portions of matter, but about regions of spacetime. The idea would be something like this. Clifford/Odie has a particular path, *P*. That region of spacetime has certain properties instantiated at it, and certain causal relations underlie the pattern of the instantiation of those properties, including some backwards in time causal relations. The properties instantiated at *R* suffice for a dog-shaped statue to be located at *R*. The maximal timeslice of *P* which includes *R* also has properties instantiated at it sufficient for a dog-shaped statue to be located there. These patterns of property instantiation don't yet tell us anything about which objects are where: for the very same pattern of property instantiations underlies the view that different timeslices of *P* are occupied by a great many temporal parts of one thing, or whether they are occupied by one thing many times over, or something else. So we must add some facts about location; as endurantists, we add these further fundamental facts so as to make Odie be located at every timeslice in *P*, as well as at some proper subregions of those timeslices, such as *R* (If the remarks made about recombination earlier in this section are correct, this pattern of instantiation of location will be a genuine possibility). And there we stop; the proposal is that the pattern of local property instantiations in regions of spacetime, plus the global pattern of locations of material things, plus the mereological relations on regions of spacetime, is a complete supervenience base (In particular, we do not include the mereological structure of material things among the fundamental properties, and let that structure emerge in whatever way is consistent with the fundamental facts just specified).

Given that kind of picture of the fundamental ontology of endurance, we aren't moved at all to conclude that just because we assigned Odie to *R* and to a superregion of *R*, that Odie must be a proper part of itself. Such mereological relations on things play no fundamental role in this version of endurance, and may even be dispensed with altogether, though some locative relations can play much of the theoretical role formerly occupied by mereological relations (In particular, proper contraction can largely fill the role of proper part). Note that minimal extensional mereology is satisfied; indeed, the full strength of classical extensional mereology is probably satisfied, for the only non-trivial relata of mereological relations are spacetime regions which stand in the mereological subregion relation.

I have not offered a defense of this kind of endurantist ontology. I merely offer it as a way of starting to make intuitive sense of the consistent scenario which captures as much as possible of Kleinschmidt's original inconsistent case.[14]

5 Conclusion

I am no endurantist. But it is important to me that the debate between endurance and its rivals be genuine and substantive. This will not be the case, if the notion of multiple location fundamental to the most clearly articulated versions of endurantism turns out to be conceptually incoherent. The incoherence of multiple location would be the upshot of both Kleinschmidt's and Barker and Dowe's arguments: in both cases they offer, the purported contradiction arises from the description of the case as involving multiple location. Thankfully, neither purported contradiction is genuine. Barker and Dowe's case, when correctly described using the resources of the theory of location, turns out to be perfectly coherent. And while Kleinschmidt's case is incoherent, the culprit is a familiar one: the difficulty of keeping everything straight when time travel is involved. Multiple location is innocent, and close but coherent variants of her case do involve multiple location.

I certainly don't think that this amounts to a positive argument for endurance, or that it allows us to avoid the more familiar puzzles that change over time is thought to pose for endurance. What I have done is preserve the opportunity for endurantists to avail themselves of multiple location in providing a transparent characterisation of their view. That way, at least, the persistence debate needn't involve accusations that one side is simply conceptually confused, even if what they defend ultimately turns out to be false, or even necessarily false.

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[14] It's also a picture which can make sense of the endurantist ontology one is left with if one accepts van Inwagen's 1981 arguments against DAUP. He tells us that, for example, there is strictly and literally speaking no such thing as Descartes' left leg. One way to make sense of that is what I've just sketched in the main text: that the fundamental ontology just contains material wholes which have locations, and then various properties that their locations have which can be used to ground derivative talk about apparent material parts of those things. So Descartes has a location; and that location has a left-leg-ish subregion; but strictly and literally speaking, Descartes stands in no interesting mereological relations at all.

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