

Location and Perdurance

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Two views dominate the contemporary discussion of persistence. *Perdurance* is the view that objects persist through time by having distinct parts ('temporal parts') at each moment at which they exist, so that persistence through time is just like ordinary extension through space. *Endurance* is the view that objects are wholly (not merely partially) present at each moment at which they exist, and objects thus persist through time by being present at different times. These different views give rise in turn to distinctive views on further metaphysical topics.

Recently, Cody Gilmore (2007) has used some of these further consequences to develop an argument against perdurantism and in favour of endurantism. More specifically, he argues that perdurantism and endurantism involve different conceptions of what the *location* of a persisting object is, and that in certain cases, the perdurantistic conception of location seems to force the perdurantist to accept that there are *coincident* objects: distinct objects constituted by the same things and occupying the same location. Given that most philosophers reject the possibility of coincidence, this situation is a cost to the perdurantist.¹ When one recalls that many take the supposed ability of perdurance theory to explain away cases of coincidence to which the endurantist appears committed to be the strongest argument in favour of perdurance, the cost is even more

¹This prohibition on coincident objects is nevertheless compatible with an object and its distinct constituting matter sharing a location (Fine, 2003), as long as the matter does not also constitute itself.

pronounced.²

But I'm not convinced that Gilmore's argument succeeds. In what follows, I'll start by setting up the theory of locations and the various accounts of persistence, then describe Gilmore's ingenious cases and the conclusions he draws from them. I'll then argue (in section 5) that the perdurantist has at least one natural and plausible response, which incurs no significant costs for the perdurantist: that is, the perdurantist can respond to Gilmore's cases without accepting coincidence and without abandoning the advantages of perdurantism in dealing with other problem cases. I'll sketch another, perhaps more conciliatory response as well, in section 6: this account may be of less interest to perdurantists, because it concedes much to endurantism, but perhaps for that reason will be more acceptable to such neutral parties as still exist in this debate. These responses have independent interest as they articulate and clarify aspects of the perdurantist picture which haven't been sufficiently attended to. While I think Gilmore's arguments ultimately fail, attending to them is of great importance for perdurantists, both to address a novel challenge and to further clarify what the view involves.

1 Locations

I assume that we have some background theory of spacetime regions, and some standard theory of mereology (which mereological theory to use will be discussed below, section 5.2). It is worth noting, I think, that little in the present discussion depends on any particular theory of regions. One can safely think of regions as being just whatever those things are that an object can be found in. I will throughout the present paper make the fairly standard assumption

²For example, Ted Sider argues that for problematic cases of coincidence, 'if we believe in [perdurance], we can dissolve these and other puzzle cases; if we do not, we are left mired in contradiction and paradox' (Sider, 2001: 10).

that regions are fundamentally made of points.³ Officially, regions will thus be mereological fusions of points.⁴ The following theory is also relativistically acceptable; for convenience I will mostly talk of temporally unextended regions, but this locution is intended to be neutral between the relativistic concept of a region all of whose subregions are spacelike separated from one another, and the pre-relativistic concept of an region of instantaneous duration (a ‘time slice’).⁵

The theory of location I use is related to one recently developed by Josh Parsons (2007). The primitive notion I shall use is that of *occupation* of a region by an object. To fix ideas: an object occupies any spacetime region in which it can be found; relatedly, if indicating a region R would be a correct answer to the question ‘where is O ?’, then O occupies R . So I occupy my office; I can be found in my office, and if someone asked where I was, ‘the office’ would be a correct answer. With occupation as the primitive, we can introduce some defined notions:

Containment O is *contained* in R iff each part of O occupies a subregion of R .

Filling O *fills* R iff each subregion of R is occupied by O .

Location A *location* of O is any region R that both contains O and is filled by O , as long as no proper subregion of R contains and is filled by O .

By way of illustration: I am contained in my office, because each of my parts occupies my office. If I was half out of my door, I could still be found in my office, but I would not be contained in my office because some of my parts would

³Fairly standard, but not universal: see Tarski 1929 and Arntzenius 2003.

⁴Though, in line with standard approaches (Cartwright, 1987), I will sometimes model the mereological relations set-theoretically, particularly in section 6.

⁵As Gibson and Pooley (2006: 163) propose, a temporal part should ‘exactly occupy a region that is spacelike’; but I agree with their further claim that distinctively temporal parts of persisting objects aren’t of particular significance in the relativistic context. (Though a perdurantist view that retains a special role for distinctively temporal parts will be discussed in section 6.)

be outside that region. I do not fill my office, because some subregions of my office are free of me; I do fill the region of the interior of my head, as I have parts in each subregion. My location is a region I fill and am contained in; the region of my body is thus my location, as no proper subregion of my bodily region contains me. It should be noted that I haven't assumed any constraints on which regions can be locations; I believe the present theory is compatible with both 'liberal' theories of receptacles (Hudson, 2002), as well as more moderate views (Uzquiano, 2006).

Nothing in this theory commits me to the uniqueness of locations, and so this theory is compatible with the possibility of multiple location. This possibility arises because of the way that containment is defined; as it stands, an object can be contained in R if all of its parts are in R , whether or not those parts are also elsewhere. It seems perfectly intuitive to me that containment involves the object being (to use Parson's terminology) *wholly* within a region (every part of the object is in the region), whether or not it might also be *entirely* within that region (everywhere disjoint from the region is free of the object). By contrast, suppose we had defined:

Containment* O is *contained** in R iff no part of O occupies any region not overlapping R .

If this was used in the definition of location, multiple location in the intuitive sense would not have been possible. But we can still define a location* in the obvious way, as a region filled by and containing* a given object, and we see that while objects may have many locations, they only have one location*—where the former is any region wholly filled by an object, and the latter is any region entirely filled by an object.⁶

⁶Parsons (2007) introduces the notion of 'exact location', which is my location*; he makes no use of my notion of location.

The possibility of multiple location is why we need the additional clause in the definition of location. Consider instead the simpler definition:

Location \dagger A location \dagger of O is any region that both contains O and is filled by O .

If an object is multiply located in the intuitive sense, in that it fills one region R that contains it, and also fills another disjoint region S that contains it, then its locations are R and S , but its locations \dagger are R , S , *and* their fusion $R + S$. But I do not think that the fusion $R + S$ is intuitively amongst the locations of the object. For one thing, a non-scattered but multiply located object turns out to have a scattered location, severing the connection between the topology of an object and the topology of its location. For another, counting the fusion of the locations as a location seems to double count the locations. These counterintuitive results are avoided, and the spirit of the idea of multiple location preserved, if we restrict the locations of an object to those smallest minimal regions that it is contained in and fills, as my definition of location does. (But I'll reconsider location and location \dagger in the next section when discussing endurance.)

2 Theories of Persistence and Locations

Before I proceed to describe Gilmore's cases and argument, I need to be a bit more precise about perdurance and endurance and their relation to the theory of location.

The perdurance theory I will discuss is the so-called 'worm' theory (Lewis, 1983).⁷ This view says that ordinary persisting objects have both spatial and

⁷Another perdurantist view is the 'stage' theory (Hawley, 2001; Sider, 2001), which shares with worm theory a commitment to the existence of worms, but denies that terms for ordinary continuants refer to worms. Gilmore-style worries arise for the stage theory, but nothing specific to the stage theory needs to be said in response—the solution I propose for the worm

temporal parts, so that each such object is spatially and temporally extended—a ‘worm’—with parts in each time and place where (when) the object exists. A continuant object occupies many regions, according to the perdurantist, but is contained only in temporally extended regions; the locations of a perduring object are thus temporally extended. A perduring object is wholly located in no temporally unextended region, though it has parts whose locations are temporally unextended—temporal parts. Perdurantists maintain that spatial and temporal extension are just species of the more general notion of extension, which in turn is analysed as having parts at different regions.

This point provides the main contrast with endurance, which claims that persisting objects do so by existing entirely at each moment at which they exist. As it is sometimes put, an enduring object is ‘wholly present’ at each moment at which it exists (Haslanger, 2003: 317–8). The natural way to understand this locution is in terms of our notion of wholly located, so that an enduring object is contained within a temporally unextended region at each time at which it exists. An enduring object is such that if it exists at a time, it wholly exists at that time (it is contained in that time). This entails, of course, that enduring objects are temporally multiply located (Gibson and Pooley, 2006). Though some object to this (Barker and Dowe, 2005), it is straightforwardly compatible with the plausible theory of location articulated above. On this version of endurantism, persisting objects have zero temporal extent (they are genuinely three-dimensional), and persist by existing at—being located at—many different times.

One surprisingly common way to understand this temporal multiple location relies on the notion of an extended simple, which is an extended object with no proper parts. If such things are possible, then if they occupy a region, they are view works equally well for the stage view, so I won’t discuss the latter explicitly in what follows.

contained in it (by the definition of containment). An extended simple is then located[†] in every region they fill (Parsons, 2007: 212). However, the locations (according to the definition above) of an extended simple are the smallest regions it occupies, which are points in the present framework. If you believe in extended simples, and think that they have an extended location, that is one reason to prefer location[†] as the right conception of location in the intuitive sense. However, the counterintuitive results this produces in the most easily understood cases of multiple location make this quite unappealing in my view, particularly when combined with the controversial belief in extended simples.⁸

Accepting extended simples allows for a conception of endurance according to which objects persist by being extended temporal simples (though they won't in general be spatial simples): such things are therefore wholly located at each time at which they exist, in virtue of being extended across many times but lacking parts at those times. As Parsons shows, this version of multiple location based on extended simples can be used to define endurantism quite naturally, in much the same way as I did above. This version of endurantism maintains that persisting objects persist simply by filling a temporally extended region, but have no determinate temporal extent at all, since they are located in regions that have no temporal extent, and are also located[†] in regions that have temporal extent the same as the duration of the object's persisting, and located[†] in regions of every extent between these extremes (van Inwagen, 1990: 251–2).

Whatever the status of these debates over location versus location[†], and over the existence of extended simples, both conceptions of multiple location

⁸My view may have a decisive advantage over its rival when it comes to time travelling objects, which play a crucial role in what follows. For if an object travels through time by making an instantaneous jump (perhaps living the first part of its career from 1997 to 2008, and the remainder from 2017 to 2020), it will be a disconnected object—but will also be (temporally) simple, if the second conception of endurance is right. But, unless it is supposed to be multiply located in my first sense, I find the idea of an extended scattered simple very puzzling, and the temporal version no easier to understand. The worry is naive: but how can something have one scattered location (as opposed to many non-scattered locations) except by having a part at each disconnected part of the location?

will provide an adequate version of endurantism. Both views are united in their denial of temporal (proper) parts, the most significant marker of opposition to perdurantism. Crucially, both views agree that enduring objects are multiply located, and are located at every time at which they exist (though one may dispute whether these locations are intuitively accurate if the extended simple version of endurantism is adopted). If anything, the extended simples view is simply a way of spelling out the basic requirement of endurance, that persisting objects be multiply located. The differences between the views do not affect materially the substance of my argument, though it remains an interesting question which of these two conceptions is the right one for an endurantist to make use of.

Let me now introduce some new terminology (adapted from Gilmore) to help capture these positions. Let an *S-region* of *O* be a maximal temporally unextended subregion of a location of *O*. S-regions correspond to what we intuitively regard as spatial locations of objects at particular moments in their career. It is fairly obvious that restricting an endurantistic location to a temporally unextended region will simply yield the same location back again, since endurantistic locations are temporally unextended to begin with. So it is natural for an endurantist to believe that the locations of an object are its S-regions. Of course, the way I have defined the concept, this is a trivial observation. But many people, including Gilmore, take themselves to have direct evidence as to what the S-regions of objects are, based on the idea that they are connected with spatial locations of objects at times. The idea is that an S-region is simply to be defined as a region we would ordinarily regard as the location of an object—it then follows, as a matter of fact rather than definition, that S-regions are maximally temporally unextended subregions of objects. Armed with direct opinions about S-regions, the trivial connection for the endurantist between

S-regions and locations will allow one to discern the locations of an enduring object.

It is equally obvious that no perdurantist could think that the location of a perduring object is an S-region, as no perduring object can be contained in a temporally unextended region. However, if we follow one standard definition of a temporal part, S-regions can be the locations of instantaneous temporal parts. According to Sider (2001: 60), x is an instantaneous temporal part of y at t iff (i) x is part of y ; (ii) x exists wholly at t ; and (iii) x overlaps every part of y that exists at t . Let R be the location of some object O ; let R_t be the temporally unextended subregion of R at t . Then if O_t is O 's instantaneous temporal part at t , and R_t is the location of O_t , then R_t fulfils the conditions for being an S-region of O (R_t is maximal, and so contains every part of O_t ; R_t is a subregion of R and so is filled by O_t).⁹

Even if S-regions cannot be locations of perduring objects, they may still be used to define locations. It is an obvious and natural principle that the location of an object is determined by the locations of its parts. One specific way—but not the only way—of fleshing out the natural principle is to claim that the location of an object is the fusion of the locations of its parts: that is, the location of an object is that region which has as subregions all and only the locations of the parts of the object. Every temporally unextended part of a perduring object is part of an instantaneous temporal part, and every temporally extended part of a perduring object is a fusion of temporally unextended parts, so in defining the location of a perduring object we need only consider the locations of its temporal parts. So the location of an perduring object is the fusion of its S-regions. Gilmore terms the fusion of the S-regions of an object its

⁹Note that it is possible that O 's temporal part at t may be identical to O 's temporal part at $t' \neq t$, if that temporal part is multiply located. We thus liberalise Sider's conception, as he requires that a temporal part exist at one and only one time. We could also define non-instantaneous temporal parts, following Parsons (2007: 216, eqn. 10).

path. Using this terminology, the preceding discussion suggests that the location of a perduring object is its path.

However, according to the view that locations are paths, multiple location of a perduring object is impossible. Even if an object's temporal parts are multiply located, in the sense that one temporal part may be wholly located in disjoint S-regions, it will still be the case that there is just one path associated with a given set of S-regions (because any such set has a unique fusion), and thus just one location. Given that endurantism and the general theory of location are both compatible with multiple location, it must be seen as a cost associated with perdurantism to rule it out (though perhaps only a slight cost). Yet we can easily save the possibility of multiple location: define a *sufficient collection* of S-regions as any set C of S-regions for an object O such that every temporal part O_t of O has a location $c_{O_t} \in C$. Call a *sufficient path* the fusion of the members of a sufficient collection. The path of an object is a sufficient path, but the converse does not hold: If a temporal part of the object is multiply located, there will be more than one sufficient collection, and hence more than one sufficient path.

Since the fusion of sufficient paths is also a sufficient path, we can't simply say that a location of a perduring object is a sufficient path, for the reasons outlined in section 1. To bring the theory into line with the earlier definition of location, we must restrict our attention to those sufficient paths which do not have a sufficient path as a proper subregion. Calling such a path a *minimal sufficient path*, it follows that locations, for the perdurantist, are minimal sufficient paths.¹⁰ It seems inconceivable that a perduring object could be multiply

¹⁰Even here there is room for dispute. Consider O , which has two temporal parts, each of which is spatially bi-located. O therefore has four minimal sufficient paths. But, intuitively, it might seem that the bi-location of O 's parts is due to O being bi-located, not quad-located. We could get this outcome if we insist that a location should not overlap another location, and thus insist that O 's locations are the members of a maximal set of non-overlapping minimal sufficient paths. But there is more than one such set, which seems to introduce a distressing arbitrariness as to which set gives the 'real' locations of an object. I do not

located (rather than merely *scattered*) without having multiply located parts; thus if we adopt the notion of a minimal sufficient path as giving the perdurantistic concept of location we will at least have managed to give an account which is in agreement with the intuitive theory of location and is natural and attractive to the perdurantist. From now on I will take the thesis that locations are paths to mean that locations are minimal sufficient paths.¹¹

3 Coincidence Problems for Endurantists

With these preliminaries in place, we can now introduce some famous problems for endurantists involving coincidence (distinct objects, with the same constituents, in the same location). Since we are supposing that such coincidence is impossible, such cases pose problems. In the cases we examine in this section, the apparent coincidence arises only under the assumption of endurance, which provides a reason to favour perdurance.

A familiar case of this sort is the situation of Lumpl, a lump of clay, which is (at some time into its career) shaped into a statue, Goliath.¹² Lumpl exists prior to Goliath's creation, which is sufficient to make them distinct. Yet when Goliath is created, Lumpl is not destroyed, as the creation of Goliath involves simply reshaping Lumpl, and lumps of clay aren't destroyed when reshaped. So Lumpl still exists when Goliath does, and though they are distinct they seem to be coincident and made of the same constituent clay after Goliath is created. Whether the appearance of coincidence is borne out depends on what the locations of Goliath and Lumpl turn out to be, and as we have seen

therefore proceed down this route, but stick with minimal sufficient paths as my analysis of perdurantist locations.

¹¹Note that the original notion of a path still has an important role: it corresponds to the exact location of an object (the region which entirely and exactly contains the object). In the case of an enduring object, it can be easily seen that its minimal sufficient paths are each of its S-regions, so the notion of a path is arguably more useful.

¹²The case is due to Gibbard (1976); see also Sider (2001: ch. 5).

perdurantists and endurantists have differing views on what locations are.

For the perdurantist who take Goliath and Lump1 each to persist by perduring, the location of Lump1 should include the locations of each of Lump1's parts, and since Lump1 exists prior to Goliath's creation, Lump1 has parts that exist before any of Goliath's parts. Therefore we can at least say that the location of Lump1 is distinct from the location of Goliath, as there are regions Lump1 occupies that Goliath does not. This follows straightforwardly from the thesis that a perduring object is partly located wherever its parts are located, which in turn follows from the thesis that perdurantistic locations are (minimal sufficient) paths. The threat of coincidence is avoided if the objects perdure.

Locations are S-regions for the endurantist. Lump1 thus has some locations that Goliath lacks, in virtue of pre-existing Goliath, and thus Goliath and Lump1 are distinct. But there are apparently many S-regions and thus locations which Goliath and Lump1 share. In each of those locations, both Goliath and Lump1 are wholly present, and as they are distinct there are two distinct objects wholly present in the same location. Assuming as we have throughout that such coincidence is impossible, endurantism is committed to an impossibility.

The problem arises because there are objects which share some but not all of their S-regions. The perdurantist proposes that these objects share some but not all of their (temporal) parts, and that the overlap of parts explains the partial overlap of location. But because endurantists regard S-regions as locations, sharing an S-region just is sharing a location, which quickly leads to coincidence problems.

Considering this situation and others like it, it has been popular to conclude that the ease with which perdurantists can sustain the anti-coincidence principle, while the endurantist has difficulty, provides support for perdurance as an account of persistence. These cases are far from decisive, as becomes ob-

vious when we consider further, more or less distantly related cases: What if Goliath and Lump1 are each created at the same time and thus share *all* their S-regions? What of the coincidence problems for the temporal parts of Goliath and Lump1 that exist after the creation of Goliath and which (it is tempting to think) must ground in their properties the modal differences between Goliath and Lump1? Both perdurantists and endurantists have to say something about such cases in order to uphold anti-coincidence, and it is pretty clear that what the perdurantist says about the version of Goliath and Lump1 discussed above is not going to help with the variants just mentioned.¹³ But it should be (and generally is) admitted that the argument provides some presumptive support for perdurantism under the anti-coincidence assumption.

4 Gilmore's Cases

Analogous problems would arise for perdurantists if it were possible to have distinct objects which shared no S-regions but did have the same path. Such objects would not be coincident if they endured, but would be coincident if they perdured. Cody Gilmore has given putative cases of just this sort, by making an ingenious appeal to the possibility of backwards time travel. So before giving his cases I'll need to quickly discuss time travel and persisting objects.

The standard story goes like this (Lewis, 1976). For many persisting objects, the conditions under which an object at one time is the same as an object at another time involve causal connections of specific sorts between those objects. For example, Locke (1976: §27) appears to claim that some things are the same *person* just in case the experiences of one object cause the other object to be in a position to veridically recall those experiences. In normal cases, these identity-

¹³In these other cases, the perdurantist's best response is apparently to deny the distinctness of Goliath and Lump1, usually by denying the existence of robust *de re* modal differences that would ground distinctness.

constituting causal processes happen in a straightforward temporal order: the causes temporally, as well as causally, precede their effects. But if we can conceive of backwards causation, we can conceive of a case where the appropriate causal relationships hold between the object at one time, and the object at another time, but where the order of the times is out of step with the normal order for intrinsically similar causal relationships. So, if a person steps into a time machine and travels back in time, they can be the same person because they remember various experiences of their causally prior selves, even though those selves may be many years in the future. Lewis introduces a distinction between ‘external’ time and ‘personal’ time, where the latter is a derivative temporal metric induced on a sequence of events by tracing the causal relations between them and ordering them as surrounding intrinsic duplicate (or near-duplicate) causal processes are normally temporally ordered (if there is such a prevailing order). Since objects are unified by causal relations holding between the object at different times, each object has a personal time characterised by the normal temporal order for objects intrinsically like it causally. An object time travels, says Lewis, if its personal time comes apart from external time.¹⁴

I can now introduce Gilmore’s two cases. Both have a similar structure; one is, he claims, ‘physically more plausible’, but both rely fairly heavily on backwards time travel and are thus at most as plausible as that possibility.¹⁵ Nevertheless, backwards time travel is intuitively possible, and the easy way in which perdurantists can make sense of it has been used as an argument for perdurance. It is certainly fair to use it in setting up cases that are potentially problematic for the perdurantist, even if those cases aren’t nearly as obvious

¹⁴It is sometimes objected that an endurantist cannot even make sense of time travel; I will here assume that this objection is false, and point to Keller and Nelson (2001: section 9) for arguments.

¹⁵The second case, of Adam and Abel, uses a more physically plausible version of Gödelian time-travel, permitted in some models of general relativity (Earman, 1995: ch. 6). But there is no evidence that our world is one of those which permits such time travel.

and familiar as cases like Goliath and Lumpl.

Case 1 (Cell and Tubman). Suppose that some cell ['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 end of the year 2002. The cell's entire career is confined to this three-year interval. Suppose also that the cell never leaves the immediate vicinity of my bathtub. If this cell's trips were structured properly, if it made enough of them, and if it underwent the right sorts of intrinsic changes along the way, the cell might compose some macroscopic object that sits in my bathtub for three years. Indeed, the cell might compose an object that by all appearances is a conscious, intelligent human being ['Tubman'], one who exhibits the strange behavior of living in my bathtub, and whose constituent cells seem to pop into and out of existence, but who is otherwise quite normal. (Gilmore, 2007: 182)

The endurantistic analysis of this case appears straightforward. Had Cell not been a time traveller, it would have been wholly located at each moment at which it existed, and thus temporally multiply located. By allowing Cell to time travel in such a way as to overlap itself temporally, we turn temporal multiple location into spatial multiple location: Cell is wholly located in many places at each time at which it exists, so (by the endurantist definition of location) it has many S-regions at each time. Tubman has a part located wherever Cell is located, because Cell is part of Tubman, so Tubman's S-region at t is the fusion of the S-regions of its parts at t . That is, Tubman's S-region at t is the fusion of all of Cell's S-regions at t . Since a fusion of several things is not identical to any one of those things, Cell and Tubman have no S-regions (locations) in

common. There is no threat of coincidence for these distinct objects.

For perdurantists, who accept that a location of a persisting object is any of its minimal sufficient paths, the case is more problematic. Had Cell not been a time traveller, it would have had a great many temporal parts stretched over a considerable period of time. When Cell time travels in such a way as to overlap itself temporally, these parts have a more compact arrangement, and compose Tubman. There is a strong intuitive pull, however, toward regarding Cell's S-regions as just the same as for the endurantist, though now they are all the locations of Cell's temporal parts. Indeed, Gilmore suggests that 'philosophers on both sides of the endurance v. perdurance dispute can all agree on... which regions are *O*'s S-regions' (Gilmore, 2007: 179). As such, Cell's S-regions differ from Tubman's S-regions. But the fusion of Cell's S-regions at each moment is Tubman's S-region at that moment; so the fusion of Cell's S-regions at every moment just is the fusion of Tubman's S-regions at every moment. So the (minimal sufficient) paths of Tubman and Cell are the same, and for a perdurantist, Cell and Tubman are co-located. But they are also distinct. If the distinctness of their S-regions weren't enough to convince us of distinctness, these further facts intuitively should: (i) Cell time travels, while Tubman doesn't; (ii) Cell exhibits no conscious behaviour, while Tubman does.¹⁶ As such, we have distinct but co-located objects, and hence coincidence. Assuming as we have throughout that such coincidence is impossible, the perdurantist is apparently committed to an impossibility.

Before evaluating this case of Cell and Tubman, let me describe Gilmore's other case:

Case 2 (Adam and Abel). Consider... the career of a hydrogen atom,
which we shall call 'Adam.' Adam is spatially bi-located throughout

¹⁶I'll re-evaluate this supposed distinctness in section 5.3; for now, I'll accept it as intuitively plausible.

its two-billion-year-long career. For any given moment of external time (or ‘global simultaneity slice’) t in the relevant universe, Adam is present at t ‘twice over:’ i.e., there are *two* different moments pt and pt^* of Adam’s proper time such that, at pt , Adam is present at t , and at pt^* , Adam is present at t . Suppose that, at each moment of Adam’s proper time, Adam is chemically bonded to itself at a different moment of its proper time, thus forming a molecule of H_2 , which we shall call ‘Abel.’ Abel is spatially mono-located throughout its career (which is only one billion years long). For any given external time t , Abel is present at t only once: i.e., there is only *one* moment of Abel’s proper time at which Abel is present at t . (Gilmore, 2007: 186–7)

As in the case of Cell and Tubman, the endurantist has an obvious analysis of the case of Adam and Abel: they share a path but none of their S-regions, so while they are distinct, they are not co-located. We can give additional grounds for the distinctness of Adam and Abel, as Adam, but not Abel, has a career extending over 2 billion years; and Abel weighs more than Adam over their entire careers. But again, if they are distinct, the perdurantist is committed to the impossible situation of distinct coincident objects.

4.1 Options for the Perdurantist

There are two obvious ways for the perdurantist to resist the conclusions Gilmore draws about these cases. The first is to deny the distinctness of Cell and Tubman (and Adam and Abel); the second is to deny that they are co-located. As I will now go on to argue, both ways are independently plausible and could be attractive to the perdurantist. Indeed, views that reflect these ways are already part of the established literature on perdurance (though the first response, dis-

cussed in section 5, is deservedly more popular). The responses I discuss are alternatives: each of them individually suffices to defuse Gilmore's cases, but it is not plausible that a single perdurantist should appeal to both. Whichever alternative is chosen, however, we can conclude that no significant threat is posed to perdurance by Gilmore's ingenious cases. The value of the cases remains however; they do show that erroneous ways of thinking about perduring objects are very easy to slip into, and that caution must be exercised to remain clear on what the view does, and does not, involve. In what follows, I'll first explore the prospects for denying the distinctness of Cell and Tubman (section 5), then explore the prospects for denying their co-location (section 6).

5 Denying Distinctness

5.1 S-regions revisited

Part of Gilmore's argument from his two cases is that, if perdurantists and endurantists agree on the S-regions, they will agree on the distinctness of the objects in question. For, the reasoning goes, how could objects that were not distinct manage to have different instantaneous spatial locations?

It is in fact fairly obvious that the perdurantist has no reason to agree with the endurantist on the S-regions of the objects in question. Recall that an S-region is a maximal temporally unextended subregion of a location (section 2). That captures precisely the intuitive concept of an instantaneous spatial location: namely, it is the region which is the overlap (intersection) of a temporally extended location with a particular time (itself conceived of as a maximal spacelike fusion of points). It follows immediately from this that, if an object has just one location, it has just one S-region at a time, because intersection is a function. So if Gilmore is right in contending that there is just one path for

Cell and Tubman, and paths are locations, then it follows immediately that the S-regions of Cell and Tubman must be the same as well. So it is not the case, as Gilmore uncritically supposes, that ‘philosophers on both sides of the endurance v. perdurance dispute can all agree on... which regions are *O*’s S-regions’: if Gilmore is right that the perdurantist is committed to Cell and Tubman having the same location, the perdurantist should be equally committed to Cell and Tubman having all the same S-regions. Exactly the same goes for the case of Adam and Abel.¹⁷

This outcome, notice, is precisely what perdurantists have accepted all along. For consider what the perdurantist says about the familiar kind of time travel case, in which an older stage of a person visits a younger stage (perhaps to pass on some sage advice). In these cases, both stages are parts of a person, but they are not temporal parts, because they are not maximal (neither overlaps every part of the person existing at that time, because neither overlaps the other). The object that is the temporal part of the person at that time is a scattered object, which has both stages as its only parts. And it is the location of this temporally unextended scattered object which is the person’s S-region at that time. Nothing different from this case goes on in the Cell/Tubman case or the Adam/Abel case: and in each of those cases, the S-regions of the two purportedly distinct objects should be maximal objects also (though, given the description of the case, they will not be scattered).¹⁸

The sameness of S-regions derived from the sameness of perdurantistic lo-

¹⁷It is, of course, possible to insist that Cell and Tubman do have distinct S-regions (see p. 21); but on the present conception of S-regions, that will entail that Cell and Tubman have different locations (since the S-region which is Cell’s but not Tubman’s, say, will be part of Cell’s location but not Tubman’s), which would obviously undermine Gilmore’s argument.

¹⁸Of course this has the consequence that a person’s temporal part at a time needn’t itself be a person stage, and relations of personal identity do not necessarily hold between a person’s temporal parts, but sometimes hold between proper parts of those parts. But this is hardly inconsistent with intuition or commonsense, nor does it give rise to any great difficulties for perdurantism generally, except one needs to be careful when stating conditions of identity over time.

cations significantly undermines the argument for the distinctness of Cell and Tubman. Gilmore is careful to conclude that, while he takes the distinctness of S-regions to be sufficient for distinctness in his two cases, he doesn't think it is the only argument; I'll consider his other arguments below (section 5.3). For now, however, we can conclude that the perdurantist doesn't yet have a good reason to accept distinctness in those cases: not only are the overall locations of the pairs of objects the same, but so are the locations of their temporal parts.

Something odd remains, however: the present conception makes it so obvious that the S-regions of Cell and Tubman are the same that Gilmore must be using a different conception of S-regions. The most plausible thought, and something that I mentioned above, is that Gilmore thinks that S-regions are not derivative from locations, but are instead themselves fundamental (or at least, they are closely associated with something fundamental, i.e., endurantistic locations). Gilmore's informal glosses on the concept of an S-region strongly suggest this interpretation: he argues that an S-region 'corresponds to what we would ordinarily think of as a spatial location of *O* at some instant in *O*'s career' (179), and on this conception one can see how an endurantist would regard S-regions as independently specifiable. But the account of S-regions given in section 2 makes perfect sense of this gloss: for in all ordinary and common cases, not involving this kind of backwards time travel, the intersection of a location and a time *is* precisely what we ordinarily think of as a spatial location at an instant, and moreover this intersection is the location of a temporal part of an object. The perdurantist therefore is perfectly at liberty to accept that, in ordinary cases, the concept of an S-region is useful because it tracks the theoretically important concept of the location of a temporal part. But the perdurantist thereby incurs no commitment to regarding the notion of an S-region as a theoretically significant notion in its own right in all cases; and

the perdurantist will take the lesson of Gilmore's cases to be just that there are situations where S-regions don't pick out any fundamental feature of a persisting object.¹⁹

Importantly, the perdurantist has no need to accept the endurantistic thesis that, when an object has two contemporaneous stages, the object is multiply located at that time and thus has multiple S-regions. The much more natural thing to say, for the perdurantist, is that the object has two distinct parts, in different locations, and is merely scattered. But, as is quite clear, scattered objects do not thereby have multiple S-regions. Below, when I consider co-location-denying responses to Gilmore's argument, I'll return to the question of whether the perdurantist can adopt an alternative conception of S-regions according to which it is possible for a scattered object to have multiple S-regions at one time (section 6). For now, I conclude, the perdurantist has no good reason to accept distinctness of Cell/Tubman, or Adam/Abel, on the basis of distinct S-regions.

Even so, the endurantist could dig in at this point, and while defining an S-region as 'what we ordinarily judge an object's spatial location at a time to be', also insist that, having read the Cell/Tubman scenario, we ordinarily and pre-theoretically want to say that Cell has numerous small cell-shaped locations at t , and that Tubman has just one, medium-sized, man-shaped location at t . It will then follow from this insistence that Cell and Tubman have distinct S-regions (and it will follow that S-regions cannot be defined as maximal temporally

¹⁹I think part of the intuitive appeal of Gilmore's account of his cases rests on the following principle, which can look plausible on first acquaintance:

Correspondence There is a one-one correspondence between S-regions of objects which are intrinsic duplicates.

But this Correspondence thesis breaks down in cases where an object time travels in such a way as to overlap itself. Given that 'number of S-regions' isn't invariant between intrinsic duplicates, it cannot be a fundamental feature of a persisting object. So even if we have some sense of what Cell's S-regions would be if it hadn't time-travelled, that gives no indication of what Cell's S-regions in fact are. By contrast, there is a one-one correspondence between the *parts* of intrinsic duplicates.

unextended subregions).²⁰ But does it then follow that Cell and Tubman are distinct? Only if our ordinary judgements about S-regions are true claims about instantaneous spatial locations. Yet it is the contention of the perdurantist that the best theoretical account of our ordinary judgments is that spatial locations at a time are maximal temporally unextended subregions of objects—a theoretical account that would make the ordinary judgment report the endurantist insists on come out false.²¹

There remains the possibility that a multiply located object can have more than one S-region at a time, if its parts at that time are multiply located. Gilmore hints at this possibility when he says of the second case that ‘Adam is present at t “twice over”’. If we take this hint literally, Adam may be multiply located in virtue of having multiply located temporal parts. But keeping the correct definition of a path as a minimal sufficient path firmly in mind, this possibility poses no problem to the perdurantist. Adam certainly will turn out to have (at least) two minimal sufficient paths, and hence (at least) two locations. If we admit that Adam can bond with its disjointly-located self to form Abel (a big ‘if’: see the following subsection), Abel will intuitively fill and be able to be contained only in the fusion of Adam’s minimal sufficient paths, and will thus have just one location. In a sense, then, we can claim that Adam is longer-lived than Abel: Adam has at least two billion-year-long disjoint minimal sufficient paths, while Abel has only one billion-year-long minimal sufficient

²⁰Thanks to Martin Thomson-Jones for pressing me on this point.

²¹If the perdurantist concedes that intuition supports the contention that Cell and Tubman have different spatial locations (and it is by no means clear that it does), the perdurantist must be committed to an error theory about the intuitive judgments. Our ordinary views are not infallible guides to what’s true about an object’s instantaneous spatial locations, because those locations are to be analysed as maximal temporally unextended subregions of the object. Since Cell is Tubman, and since intuition entails that Cell and Tubman have different locations, intuition is in error here. It is not in grave error; after all, our intuitive judgments about object’s spatial locations are correct in cases not involving time travel. And the error is explicable; I think it arises from a pre-theoretical tendency to accept the false principle I called in footnote 19 Correspondence, on the basis that spatial locations are fundamental features. But it is an error nevertheless.

path. But this is straightforwardly compatible with the perdurantistic theory of locations, and is not paradoxical at all: there are (at least) two different locations of Adam, and only one for Abel, and they all differ, so there is no threat of coincidence. In this case, indeed, the relations between the regions Adam occupies, and the region Abel occupies, exactly mimic the mereological and compositional relations between Adam and Abel themselves. Below I will consider other ways, not involving brute multiple location, for the perdurantist to avail themselves of this kind of ‘mereological harmony’ (Uzquiano, 2006: 441): see section 6.

5.2 Mereological Issues

While Tubman is apparently composed of many cells, it is crucial to Gilmore’s example that in fact those apparently distinct cells are just the many parts of the trajectory of a single time travelling cell. Similarly, while Abel is apparently a molecule composed of two atoms, it is crucial to Gilmore’s example that in fact those apparently distinct atoms are just two parts of the trajectory of a single time travelling atom. These observations should give us pause: how can it be that just one cell or atom, in virtue of time travelling, can compose, just with itself, something distinct from itself?

If we have some objects, the X s, the fusion of the X s is that object (if it exists) which has all of the X s as parts, and no part distinct from each of the X s. It is plausible to suppose that composite objects are fusions, so we may begin to address the question of whether Cell can compose Tubman by thinking about the nature of the relation between fusions (like Tubman) and their parts. This is the subject matter of *mereology*, the theory of parts and wholes, and our question will now be: can standard theories of mereology accommodate the mereological relations required in Gilmore’s cases? It turns out that the

possibility of Gilmore's cases requires a significant and otherwise unmotivated revision of the standard mereology accepted by perdurantists; as such, it is reasonable and dialectically appropriate for the perdurantist to reject Gilmore's cases as impossible.

A highly attractive theory of mereology is *classical extensional mereology*. This theory can be completely characterised by the following three claims about the nature of parthood and fusion (Lewis, 1991: 74):²²

Transitivity If x is part of some part of y , then x is part of y .

Unrestricted Composition Whenever there are some things, then there exists a fusion of those things.

Uniqueness of Composition It never happens that the same things have two different fusions.

This theory is not uncontroversial, and objections have been raised to each of the axioms (Simons, 1987: ch. 3). But this strife over mereology has divided largely along party lines, with perdurantists overwhelmingly favouring classical extensional mereology. Lewis, paradigm perdurantist, maintains that classical extensional mereology is 'perfectly understood, unproblematic, and certain' (1991: 75), and other perdurantists have largely agreed.²³ A notable aspect of the perdurantist conception of parthood is that it is *atemporal* (Sider, 2001: 55–7). That is, the fundamental relation of parthood is not relative to a time. This conception of parthood is somewhat familiar; it's the one we use when considering parthood relations amongst stretches of time (Sider's example is 'the 1960s are part of the 20th century'), or amongst allegedly atemporal items (like geometrical objects). It is certainly the natural relation for the perdurantist to

²²See also Simons (1987: part I) and Varzi (2006).

²³e.g., Sider (2001) and Hudson (2006: 5–6); Sider (2007) argues that classical extensional mereology is well motivated by considering it as an articulation of the powerful intuition that parthood is an especially intimate relation.

accept as fundamental, and because the perdurantist can easily define a notion of temporary parthood to correspond to the more familiar everyday sense, it cannot be objected that this theory is not a theory of parts and wholes in the everyday sense.

What are the parts of Tubman in Gilmore's cases? According to the perdurantist, those parts at least include an instantaneous temporal part Tub_t at each moment t of Tubman's existence. And each Tub_t also has parts: because they are made of Cell, they have the temporal parts of Cell as their parts. Indeed, each Tub_t is just the fusion of those temporal parts of Cell that exist at t ; and Tubman is the fusion of all the Tub_t s. So, by transitivity, all the temporal parts of Cell are parts of Tubman; Tubman has no parts that aren't parts of Cell, by construction. So by the definition of 'fusion', Tubman is a fusion of the temporal parts of Cell, and by uniqueness, Tubman is *the* fusion of the temporal parts of Cell. But Cell is obviously the fusion of the temporal parts of Cell; therefore, Cell is Tubman. A precisely similar argument will show that, while Atom's temporal parts fuse to form Atom, the very same parts are supposed to fuse to form Abel; by uniqueness of composition, Atom must be Abel.

Fairly clearly, it is the principle of Uniqueness of Composition that is used in the preceding argument to show that Cell and Tubman must be the same. Gilmore's cases must involve the failure of Uniqueness, but since no perdurantist accepts the failure of uniqueness, no perdurantist can accept that Gilmore's cases are genuinely possible.²⁴

It might be pressed that the perdurantist *should* reject uniqueness of com-

²⁴We have here another argument that instantaneous spatial locations of objects should be analysed along perdurantist lines, as maximal temporally unextended subregions. For since Cell and Tubman have all the same parts, they are (by classical mereology) identical; and since the instantaneous spatial locations of Tubman *are* intuitively maximal temporally unextended subregions, so too must the spatial locations of Cell be. Only if we have the antecedent conviction that Cell is not Tubman—a claim which is supposed to be the conclusion of Gilmore's argument—would we even be able to judge that there are two objects with different instantaneous spatial locations.

position. The literature certainly contains two prominent arguments to that effect:

1. If there are ‘structural’ universals (Armstrong, 1997; Forrest, 1986), they are composed of their constituent parts in a way that violates uniqueness of composition, because structural universals can be distinguished on the basis of ‘how many times’ a certain universal is part of the structural universal. For example, according to defenders of structural universals, the structural universal *methane* must contain the *hydrogen* universal four times over. But, Lewis (1986) objects, what can it mean for the same part to be part of the same fusion many times over? And it seems perfectly appropriate, in the face of this mystery, to deny that the supposed unmereological ‘composition’ involved in structural universals is composition at all—and thus reject the possibility of structural universals (Lewis, 1991: 79, fn. 8).
2. Fine (1999) objects that a fusion of two slices of bread and a piece of ham isn’t always a ham sandwich: before the sandwich is assembled, the fusion may exist but the sandwich does not. So the ham sandwich isn’t the fusion, and is rather a structured aggregate. But the ham sandwich doesn’t have any parts that differ from the fusion, so the mode of structured composition of the ham sandwich must not be classical extensional mereological fusion.

Note firstly that there is a straightforward perdurantist response (Sider, 2001: ch. 5.3):²⁵ just because the fusion of the ham and bread doesn’t at all times have the property of *being a ham sandwich* doesn’t somehow mean that when that fusion comes to have that property, some new object comes into existence. The fusion which will be a ham sandwich exists (as

²⁵See also response (5) of Lewis (1991: 78).

a widely scattered object) before it becomes a ham sandwich; when it becomes a ham sandwich it remains the same unique fusion, but, in virtue of non-mereological facts about the *arrangement* of its parts, that fusion comes to be a ham sandwich. So there aren't two modes of composition; there is classical fusion, and then there are changes that can occur to those classical fusions. In no way does this picture commit the perdurantist to non-unique composition.²⁶

Furthermore, this Finean argument isn't acceptable in the present context. For if we conclude that the fusion and the ham sandwich have the same parts but are distinct, we seem committed to the idea that where there is a ham sandwich, there is also a distinct fusion: and this would be an instance of coincidence. The assumption running behind Gilmore's argument is that coincidence is impossible, so it is not appropriate in this context to object to the classical mereological framework the perdurantist adopts on grounds that will lead to coincidence. Ruling out coincident objects rules out all the most plausible alternatives to uniqueness of composition.

I conclude, therefore, that the perdurantist has no pressing reason to abandon uniqueness of composition (consequences of doing so anyway will be explored in section 6). Given the obvious fact that, on Gilmore's description, Cell and Tubman have the same fundamental parts, they must be the same fusion, not distinct objects at all. I admit that there remains some residual worry, and note that when first hearing about the cases the intuition is that Cell/Tubman and Adam/Abel may well be distinct.²⁷ Explaining away this intuition, and

²⁶And it certainly appears to capture our intuitions about the case: if we accept the idea that a fusion is intimately related to the plurality of the parts, then since surely we'd like to say that since the plurality 'the parts of the sandwich' existed before they were made into a ham sandwich, we should accept that the fusion exists too; 'being made into a ham sandwich' is an operation that modifies a pre-existing plurality, rather than creates a new thing.

²⁷In related cases, some perdurantists have wrongly agreed that Cell and Tubman are distinct: see Effingham and Robson 2007: section 5, where they argue that in a parallel case, a time travelling brick that composes a wall isn't identical to the wall. This is just a mistake

Gilmore's other arguments for distinctness, is the task of the following subsection.

Before turning to that, it is worth thinking about the mereological principles that an endurantist must subscribe to in order to accept Gilmore's cases. The endurantist thinks that Cell is wholly present in many locations at any time when Tubman exists; and Tubman is composed of these many 'copies' of Cell. Of course, there aren't really many copies; there is just Cell distributed over many locations. Thus, we can conclude, Tubman is composed from Cell, and from nothing else. This conclusion is in tension with a principle that is extremely widely accepted, even by those who reject classical extensional mereology:

Weak Supplementation Principle (WSP) If x is a proper part of y , then there is some proper part of y that is disjoint from x .²⁸

Simons (1987: 116) (no great friend of classical mereology or perdurantism) even maintains that 'WSP is indeed analytic—constitutive of the meaning of "proper part"' (see also p. 362). But Gilmore's cases violate WSP: Cell is a proper part of Tubman, since it is part of Tubman and is distinct from Tubman, by construction. But Tubman has no part that is not identical to Cell. So WSP fails. Given the centrality of WSP to all plausible conceptions of parthood, even an endurantist should not wish to accept Gilmore's cases as possible.²⁹

Gilmore (2007: 191, fn. 32) is aware of the problem; his response is to reject the two-place parthood relation in favour of a four-place relation relativised to personal time: ' x at moment t_x of x 's personal time is part of y at moment t_y of y 's personal time'. Perhaps this relation will do the job; it is no great surprise that endurantists should prefer temporally relativised versions of relations that the perdurantist understands atemporally, and once we introduce the distinction

on their part.

²⁸A 'proper part' of y is a part of y that is not identical with y .

²⁹Effingham and Robson (2007: section 3) make a similar observation.

between personal and external time, why not relativise to the more fine-grained distinction? But it must be admitted that this relativising strategy isn't very intuitive, and moreover not every endurantist is going to want to adopt this view. In any case, these mereological issues are clearly in need of some attention from endurantists.³⁰

5.3 Explaining Apparently Distinguishing Properties

That Cell and Tubman (and Adam and Abel) are not distinct is the upshot of the previous two subsections. Gilmore tries to undermine this conclusion, suggesting for example that Cell (Adam) travels in time, while Tubman (Abel) does not; that Tubman is conscious, while Cell is not; that Abel has a 'mass history' different from Abel's. The perdurantist needs to explain these suggestions away.

The general strategy is this, letting a and b stand for two objects claimed to be distinct because one is an A and the other a B , but such that a and b have the same fundamental parts (as Gilmore claims for both pairs of Cell/Tubman and Adam/Abel): first, recalling the perdurantist thesis that for a persisting entity to be an F is for it to have temporal parts connected by the same- F -as causal relation, point out that the same- A -as relation and the same- B -as relation both hold amongst the parts of a and b . Second, note that while if those identity-constituting causal relations conflict with each other, then a (and b) is at most one of an A or a B , they needn't necessarily conflict. It is quite

³⁰Gilmore (p.c.) has given an argument for his conception of the parthood relation. Starting from the idea that composition should be unique (something which should be common to all anti-coincidentalists), different parthood relations will give rise to different ways of expressing that uniqueness. The standard two-place parthood relation, and the common endurantist three-place variant (' x is part of y at t '), both fail if we take Gilmore's cases as he describes them. So one is forced, by one's adherence to uniqueness of composition, to something like Gilmore's four-place parthood relation. And this four-place relation fits better with endurance than it does with perdurance. This may provide a reason for endurantists who accept distinctness in Gilmore's cases to accept his conception of parthood. But there is no reason for perdurantists to do so, and I also see no compelling independent reason for endurantists to accept distinctness either—endurantists could just as easily take the argument of this footnote as a *reductio*.

possible that (in virtue of the same-*A*-as relation holding amongst its parts in one way) *a* is an *A*; and (in virtue of the same-*B*-as relation holding amongst those same parts, but in a different way), *a* is also a *B*. Finally, note that many other properties—like being conscious, or having a certain mass history—are properties had in virtue of being a certain kind of thing (as the perdurantist says about other coincidence cases, Goliath may be valuable in virtue of being a statue, and not in virtue of being a lump of clay—but still, that doesn't mean that the lump of clay isn't valuable). So if *C* is some property *a* has in virtue of being an *A*, but not virtue of being a *B*, that might explain initially why it might seem that *a* and *b*, though identical, are distinct with respect to *C*.

This general strategy applies to both the cases of Cell/Tubman and Adam/Abel. In a bit more detail in the Cell/Tubman case, there is a set of parts whose fusion occupies the path of both Cell and Tubman. (The perdurantist maintains that this fusion is identical to both Cell and Tubman.) There is a way of taking those parts such that all of them can be combined into a cell: there is an exhaustive set of fusions *C* of those parts such that each fusion in *C* is an instantaneous cell-slice, and such that the same-cell-as causal relation holds pairwise between all of the members of *C*. There is also a way of taking those parts such that all of them can be combined into a person: there is an exhaustive set of fusions *T* of those parts such that each fusion in *T* is an instantaneous person-slice, and such that the same-person-as causal relation holds pairwise between all the members of *T*. These two facts about the parts that make up Cell are sufficient to show that Cell is a cell, and also that Cell is a person; similarly for Tubman. Cell is the fusion of the cell-fusions in *C*; Tubman is the fusion of the person-fusions in *T*. In standard mereology, the fusion of all the members of *C* (Cell) is the same as the fusion of all the parts of the members of *C*, and the fusion of the all the members of *T* (Tubman) is the same as the fusion of all the parts of the

members of T . It follows that, since all the parts of the members of C are parts of the members of T , and vice versa, Cell is Tubman.

There is something slightly strange about the way that the same-cell-as relations hold amongst the members of C , because some of those relations hold between instantaneous cell-slices that are separated in time by three years, and they also hold backwards in time. But these odd causal relations between those fusions in C do not undermine the obtaining of other causal relations between the members of T ; in fact, as Gilmore describes the case, the causal relations between the members of C are set up precisely so as to ensure that the same-person-as relation holds between the members of T . As long as both sets of causal relations can obtain without conflict, there seems no insuperable objection to saying that the thing made from these parts is both a cell *and* a person (i.e., has the property *being a cell* and the property *being a person*): this is a person with an additional set of causal relations between the cell-parts of which it is composed, such that those cell-parts are part of one time travelling cell.

In that case it is just false to say that Cell isn't conscious, if Tubman is. Of course Cell isn't *essentially* conscious, because had Cell not time travelled, it wouldn't have been conscious (since it wouldn't have been arranged so as to constitute a person).³¹ But as Cell happened to time travel in the precise way that it did, it managed to have a structure that was sufficiently complicated to allow it to constitute a person, while retaining (in virtue of time travel) a structure sufficient to allow it to be a cell. If Tubman is conscious, there seems little reason to say that Cell is not conscious, as the arrangement of parts and same-person-as causal relations sufficient for consciousness just is Cell's arrangement of parts and causal relations.

³¹This fits entirely neatly with the perdurantist's typical antipathy towards essential properties and robust (non-conventional) *de re* modal properties (Sider, 2001: 207): Cell is both a person and a cell, and in virtue of that fact Cell has multiple counterpart relations (or so say most perdurantists); it is an elementary error to conclude from the existence of multiple counterpart relations that there are incompatible modal properties and hence distinct objects.

Gilmore's contention that Cell time travels, and Tubman does not, can also be answered by drawing on these resources. To be a time-traveller, remember, is to be something such that the identity-constituting causal relations sometimes hold in a manner divergent from external time. But these identity-constituting causal relations are not given independently of what kind of thing is in question. (It is accepted by everyone, that the identity conditions for statues are not the same as the identity conditions for lumps of clay, even if all statues are lumps of clay.) For the perdurantist, time travel for an F just is the holding of backward causal relations that ground same- F -as over time. So there is an ambiguity in the question, 'Is *that thing* a time-traveller?'—we cannot answer it until we know what kind of thing is in question, and which identity-constituting relations we need to examine to see if they run in a way divergent from external time. Since Cell is both a cell and a person, we can ask both: Is it a time travelling cell? Is it a time travelling person? The answer to the latter question is 'no', as there are no same-person-as causal relations in this case that run backwards in time. But there are same-cell-as causal relations that run backwards in time. Whether something is a cell is independent of whether it is a person, as the argument of the previous paragraph showed. And the present argument shows that whether something is a time-travelling cell is similarly independent of whether it is a time-travelling person. There is no genuine conflict between being a time travelling cell and failing to be a time travelling person.³²

In his discussion of Adam/Abel, Gilmore rests considerable weight on his claim that Adam and Abel differ in their mass histories. He claims that Adam satisfies the property M_1 , *being an object that has a rest mass of one unit throughout its two-billion-year-long career*, while Abel satisfies the property M_2 ,

³²There is a conflict between being a non-time-travelling cell and being a time-travelling person, but that is because non-time-travelling cells cannot be persons at all, as they have no temporally unextended stages which are person stages, and hence nothing appropriate to be related to the same-person-as relation.

being an object that has a rest mass of more than one unit throughout its one-billion-year-long career. If this claim is true, and these properties are incompatible, then Adam and Abel must differ. The mass of Adam and Abel is the same: each part of one is part of the other, and the total mass of those parts must be the same for each.³³ Gilmore thus rests the argument for distinctness on the distribution of that mass over each object's career. If they have different length careers, that same mass must be distributed differently (else it wouldn't add up to the same mass for each object).

To evaluate this, let us first ask: what it is to have a career of a certain length? Existing for a certain duration of external time is arguably the fundamental physical quantity that can be possessed non-relationally; but there is no sense in which the careers of Abel and Adam differ in length in external time. The only sense in which Adam has a two-billion-year-long career is in terms of its atomic personal time. Since personal time depends on time travel, what an object's personal time is, is not a monadic property, but depends, as we saw just above, on what sameness-constituting causal relations ground the time travel. In terms of Adam's *molecular* personal time, which involves no same-molecule-as backwards causal relations, and is thus identical to external time, Adam has a one-billion-year long career. But there is no reason to think that having different length careers is an incompatible property when we are not measuring length in the same time! One and the same object can have multiple mass histories, relative to the different personal times it has in virtue of the different kinds of things it is. So Adam has a two-billion-year long atomic career, and a one-billion-year long molecular career; and we know that the mass

³³There is something strange about this, as mass cannot be an intrinsic property if we take Gilmore's hint that each temporal part of Adam is bi-located ('present twice over'). Then Adam's mass at a time will have to be twice the mass of Adam intrinsically, since Adam in each location exerts the same gravitational force. While strange, I'm more inclined to think this a curious feature of multiple location than a problem for perdurantists—particularly as multiply located enduring objects which change mass over time will also not have mass as intrinsic, or indeed much else (see the final paragraph of this section).

of the atom and molecule are the same overall. The distribution of that mass over the different trajectories is relative to the different sortals that Adam/Abel satisfies, but is no fundamental feature of Adam/Abel.

Gilmore (2007: 192–6) considers a similar ‘relativising’ approach to mass histories. While he admits it can succeed, he thinks that if adopted by the perdurantist, that perdurantist cannot in good conscience reject a similar relativising response on the part of the endurantist to the argument from temporary intrinsics. The cases are importantly disanalogous, however, because the perdurantist should not accept that these relativised mass histories are fundamental physical properties. The only mass history with a fundamental role is the distribution of mass through external time, and in external time the only mass history, shared by Adam and Abel, is M_2 . The endurantist confronted with the problem of temporary intrinsics, by contrast, *cannot* appeal to a fundamental non-relativised notion of intrinsic property. The perdurantist criticisms of relativising moves do not apply to the unrelativised mass history in external time, and that mass history is the only one the perdurantist should take as basic.

6 Denying Co-Location: Non-Extensional Mereology of Objects and Regions

What I’ve said does not go radically beyond the standard, though perhaps implicit, position of most perdurantists. If Gilmore’s cases are supposed to count as objections to the standard perdurantist position, those cases do not succeed. Most perdurantists will be content with the response in section 5, and rightly so: it comports most naturally with other assumptions about extensionality of parthood that almost all perdurantists accept. I expect, in fact, that almost all perdurantists will wish to avail themselves of the response of the previous

section. I'd strongly urge them to do so, and for what it's worth my own preferred solution is the one outlined above.

Nevertheless, I want in this section to explore an alternative proposal. One reason this is of interest is that it brings to prominence concerns about the relationship between the mereology of locations and the mereology of objects; while the discussion in this case focuses on a weak mereology, the lessons generalise. A second reason for bothering to explore this direction is that many of the observations in section 5 will seem controversial to an impartial observer. We might wish to explore some deviations from the standard perdurantist line that might mesh more closely with our immediate intuitions about Gilmore's cases, recognising that one can come across Gilmore's cases without feeling much initial resistance to the distinctness of Cell and Tubman. This seems to indicate that there is something intuitively acceptable about them being distinct. The orthodox perdurantist simply takes this to be a result of insufficient reflection on just what the cases involve, but it may be that there is more to be said in favour of that initial reaction. We should thus consider whether perdurantists can answer Gilmore's cases even under weaker assumptions than classical extensional mereology; and in particular, try to develop a perdurantist theory of locations to accompany such a weaker mereology.

The parthood relation, minimally, should be taken to be reflexive, antisymmetric, and transitive. If we also accept that weak supplementation is central to the correct conception of part (section 5.2), we arrive at the theory of *minimal mereology*, **MM** (Varzi, 2006). However, strengthening **MM** without committing to unique composition is more difficult. For example, we cannot strengthen WSP by means of the following principle (Simons, 1987: 26–9):

Strong Supplementation Principle (SSP) If y isn't part of x , then there is at least some part of y that doesn't overlap x .

In the presence of SSP, we get classical extensional mereology back: assuming that the X s fuse to form distinct y and z , since y isn't part of z , at least some of the X s don't overlap z , but that cannot be since z fuses the X s. So non-unique composition is impossible in the presence of SSP. This theory must also reject this principle, which, in the presence of WSP, entails SSP (Simons, 1987: 30–1):

Product Principle (PP) If x and y overlap, there is a thing that is part of both and has all their other common parts as parts (i.e., there is a maximal common part).

Unrestricted composition entails PP (Varzi, 2006: section 4.2), so the perdurantist who wishes to sacrifice unique composition also must sacrifice unrestricted composition. This is already a serious cost to perdurantism, as several arguments in the literature depend on the existence of arbitrary fusions (Sider, 2001: section 4.9). The interaction between supplementation principles and unrestricted fusions makes the existence of reasonably strong systems that aren't as strong as full classical extensional mereology doubtful. So for now I'll provisionally adopt **MM** as a stable way for the perdurantist to liberalise their conception of parthood.

A useful model of **MM** for our purposes can be given by considering *ordered sequences*. Assume that there are mereological atoms (objects with no parts).³⁴ Then we can model an object as a non-empty ordered sequence of such atoms without repetition; take all such sequences as the domain of our model. An atom will be called an *element* of the sequence. If we interpret the parthood relation ' x is part of y ' by the relation ' x is a substring of y ' (where a sequence T is a *substring* of a sequence S iff T is a sequence of consecutive elements of S retaining the same order as in S), we generate a model for **MM**. We can quickly show that in this model, parthood is reflexive (since every sequence is

³⁴This assumption is true in the model I'm giving, but is not entailed by the axioms of **MM**, which also have atomless models.

a trivial substring of itself), transitive (since if U is a sequence of consecutive elements from T , and T in turn a sequence of consecutive elements from S , then U must also be a string of consecutive elements from S), and antisymmetric (T cannot be a substring of one of its own substrings S unless $S = T$). We can also show that WSP is satisfied, since if T is a proper substring of S , there must be at least one further substring T' , with no substring in common between them (since S is without repetition), that is also a substring of S —obviously, it will that string or strings such that if they are concatenated with T in the right order we get S back again. But quite clearly SSP fails in this model: take the simple case of the sequences $S = \langle a, b \rangle$ and $T = \langle b, a \rangle$. Neither S nor T are parts (substrings) of each other; but every part of S overlaps (has a substring in common with) every part of T —those parts are $\langle a \rangle$, $\langle b \rangle$ and $\langle a, b \rangle$, the former of which are parts of T , and the latter of which, S itself, has parts which are parts of T . PP also fails, in the same case: S and T overlap on $\langle a \rangle$ and $\langle b \rangle$, but there is no maximal common part. So we clearly have a model of **MM** which is not also a model of classical extensional mereology. Another way to see this is to note that concatenation of sequences is the analogue of fusion in this model, and concatenation of some things gives different results depending on the order in which we take those things, unlike the case in extensional fusion. There will be more than one fusion of a single set of parts.

In the context of this model of **MM**, we can treat the case of Adam and Abel quite simply (Cell and Tubman can be treated in exactly the same way, though the case is more tedious because Cell's temporal parts are not atomic). An object is any sequence of atoms, and to model Adam and Abel, we can choose any sequences which fit the intuitions Gilmore marshals. For example (if moments of time can be enumerated), we can take Adam (the time-travelling atom) to be composed at each moment t of two spatial parts, $A_{t,1}$ and $A_{t,2}$, and take Adam

as a whole to be the fusion of these parts. Order matters in our present model, but there is a natural order to use: personal time, or causal order (since that is the order that allows us to tell that all of these parts are parts of the atom Adam). On this ordering, Adam is the fusion $\langle A_{1,1}, \dots, A_{10^9,1}, A_{1,2}, \dots, A_{10^9,2} \rangle$. Note that Adam's temporal parts are naturally taken to be a fusion of those of its parts that are simultaneous in *personal* time.³⁵ Since no pair of Adam's parts is simultaneous in personal time, Adam's temporal parts are each 1-element substring of Adam. Abel's temporal parts are also a fusion of its simultaneous parts, but as it is not a time-traveller, its personal time is the same as external time. Abel's temporal parts, then, are fusions of Adam's parts at each moment of external time.³⁶ Abel is a fusion of its temporal parts, which is, again ordered by personal time, $\langle A_{1,1}, A_{1,2} \dots, A_{10^9,1}, A_{10^9,2} \rangle$. It is obvious that these two sequences are not identical, and we can conclude that Adam is distinct from Abel. Moreover, this model captures some of the intuitions we have about the case: while the two objects have the same parts, the fact that each of Abel's parts are personally simultaneous with exactly one other part, while none of Adam's parts are, means that Adam has twice as many temporal parts as Abel, which supports the intuition that Adam's personal duration (career) is twice as long as Abel's. Their corresponding mass histories differ too, with each temporal part of Adam being heavier than each temporal part of Abel.

Taking S-regions to be the spatial locations of the temporal parts, it is fairly clear that the one-to-one correspondence between S-regions and temporal parts

³⁵If we'd chosen to take temporal parts as ordered by external time, Adam and Abel would have the same parts at each time. We are trying here to capture the intuitions Gilmore musters, to accommodate those who share them, and one of these intuitions is that personal time is fundamental in matters of composition. Gilmore, as mentioned above (p. 28) proposes to account for this by parameterising the parthood relation by personal time; the perdurantist solution here retains the atemporal notion of parthood, and implements a significant role for personal time in fusion.

³⁶We must choose one of the two possible fusions of Adam's parts at t to be Abel's part at t —there seems no objective way to prefer one over the other, so I simply stipulate that the fusion $\langle A_{t,1}, A_{t,2} \rangle$ is Abel's part. I return to this issue below.

will mean that the S-regions of Adam and Abel differ too. Continuing with the assumption from section 1 that regions are fusions of points, a region will be a fusion of points occupied by mereological atoms; an S-region will be the fusion of those points occupied by the members of a temporal part. As a path is a fusion of the S-regions, then Adam's paths are Abel's paths, and we immediately generate a coincidence scenario—but only on the assumption that the mereology of regions is classical extensional mereology. Yet having given up extensional mereology for objects, there seems no reason to retain it for regions.

It seems more plausible instead to accept that the mereological relations amongst occupied regions are isomorphic to the mereological relations amongst the occupants of those regions. So the same minimal mereology **MM** should account for the parthood relations amongst regions. The path of Adam will be a fusion of the locations of its S-regions: $\langle R_{1,1}, \dots, R_{10^9,1}, R_{1,2}, \dots, R_{10^9,2} \rangle$, while the path of Abel will be a fusion of its S-regions: $\langle R_{1,1}, R_{1,2}, \dots, R_{10^9,1}, R_{10^9,2} \rangle$. If these paths are the locations of the objects, we avoid coincidence problems by having distinct locations for distinct objects.

Having outlined one formal treatment of a non-extensional mereology that can be combined with perdurantism in a way that satisfies Gilmore's intuitions, it is clear that such a perdurantism can avoid coincidence problems. Yet many philosophical issues remain, and to these I now turn.

The first couple are technical worries about the framework. Having chosen sequences as the domain of our model of **MM**, it follows that any fusion can have only enumerably many parts (a sequence can be defined as a function from the natural numbers into some domain). This in turn means that we must treat time as having enumerably many instants, in order to allow objects to be fusions of temporal parts. This is an artifact of our simple model, and could be avoided if we'd chosen a different model for **MM**. It is a simplification, obviously, to

treat time as discrete, and I'd want a more general solution if I were seriously defending this version of perdurantism (for example, take the domain of the model to be functions from the reals into some domain). But I wanted here mostly to illustrate the idea, and ordered sequences provide an easily visualised non-extensional way of fusing some set of things. Another technical worry is that the domain of the model is sequences without repetition, and this cannot account for the case of Adam and Abel is Adam is genuinely bi-located at each time, since we would need each temporal part of Adam to appear twice in the sequence. In fact, we can't give a model of **MM** on arbitrary sequences, as WSP fails in such a model (counterexample: $\langle a, a \rangle$ has $\langle a \rangle$ as a proper part, but has no other proper part). I confess I'm not really sure how to accommodate this intuition of Gilmore's, that Abel can be composed entirely of Abel and yet distinct; perhaps an even more non-standard mereology (maybe involving Gilmore's variant 4-place parthood relation) is required for the perdurantist to make sense of this.

My more serious worries about the present framework are two: one about spacetime, the other (which I flagged earlier) about overgeneration of fusions.

The Spacetime Worry The spacetime worry is simply this: if the motivation for the anti-coincidence principle is the worry that coincident objects would 'crowd each other out' of the one location, those who endorse anti-coincidence are unlikely to be content with a non-extensional mereology of regions, as those regions too seem to crowd one another out. For there are many regions associated with one set of spacetime points; and while it's all very well to say that extensional mereology provides a notion of fusion that is much too crude for material objects, it is extremely difficult to see what motivation internal to considerations about spacetime would move one towards a non-extensional fusion operation on sets of points. Spacetime is made of points; those points

are intrinsic duplicates of one another; so setting aside purely haecceitistic differences, there seems no reason to think that the different sequences of points generated from the same underlying set of points can play any different role in being the locations of material objects. If this is right, spacetime should have an extensional mereology—and we get coincidence problems again. (Indeed, we get many more of them, as **MM** lacks unique composition, so whenever a region contains more than one atom we have more than one object fusing those same atoms in that region.)

The best way to respond to this worry, it seems to me, is to reject the ‘spacetime first’ view of regions which seems to motivate it. If spacetime is viewed as a substantial receptacle, existing before there are entities to populate it, then it is natural to worry about whether the independently given structure of spacetime can be plausibly non-extensional. But this is not the only option. One alternative is *relationism*, the idea that spacetime is not real, but is at best a useful fiction to adopt when representing genuine facts about the relations between material objects. Since it is facts about material objects which are primary on this view, it would not be at all surprising if the best mereology of the locations of objects mirrored the best mereology for objects. Another very different view of spacetime, but with the same upshot, is *supersubstantialism*—the view that material objects are to be identified with the regions of substantial spacetime that are their locations (Schaffer, unpublished). Since the location relation is identity, the mereological relations on locations will even more clearly be the same as the mereological relations on objects. Both of these views, and others besides, end up supporting the following principle:

Mereological Harmony ‘Mereological relations on material objects are perfectly aligned with mereological relations on the regions of space they exactly occupy [are located at]’ (Uzquiano, 2006: 441).

This principle is intuitively quite plausible. Nevertheless, it is not unproblematic: if there are such things as extended simples, Mereological Harmony appears to fail, for the location of an extended simple will have parts while the simple does not. Things aren't as straightforward as this, since as the discussion of section 2 made clear, there is a worry about whether extended simples have an extended location, or whether they have unextended locations but an extended location[†] (region they wholly and entirely fill)—if the latter, which is the view I prefer, Harmony can be maintained. Another difficulty for the principle is that it creates problems in the context of moderate views of which kinds of regions can be occupied (Uzquiano, 2006). So while it would help the view of the present section, and be independently interesting for a wide variety of mereological theories, Mereological Harmony is not entirely uncontroversial.

A different argument that the mereology of regions is that of continuants comes from the following intuitively plausible principle:³⁷

(SL) The shape of an object is the same as the shape of its location.

SL, as it stands, is too general for our purposes, because it has both temporary and non-temporary readings. The temporary reading claims that the shape of an object at a given time is the same as the shape of the location of that object at that time; both endurantists and perdurantists will think, for different reasons, that the temporary shape of an object at t is the same as the shape of the S-region that the object occupies at t (either by the object being located there, for the endurantist, or by the worm of the object's temporal part being wholly located in the S-region at t).³⁸ Of course, when spelled out this way the problem of temporary intrinsics immediately threatens the endurantist, so

³⁷But see Hudson 2006: 111–3.

³⁸Something like SL, notice, lies behind the intuition exploited in section 1 that the locations of a multiply located object should not include the fusion of its locations—since that fusion will generally have a different shape to its proper parts.

endurantists perhaps wouldn't accept even this version of SL.³⁹ No matter; our concern here is with the perdurantist.

Perdurantists should also recognise another sense of SL. Just as each temporal part has a certain shape, so too it seems plausible that their fusion—the worm—might have a certain shape. Some worms are very long and thin (perhaps the worm of a fundamental particle is like this). Some are shorter and fatter (perhaps the worm of the Melbourne Cricket Ground is like this). The shapes that worms can have are surely different from the shapes that temporal parts of worms can have. Moreover, the shape of a worm surely depends on the shape and arrangement of its temporal parts, so one might suspect that worm shapes, and non-temporary shape in general, should be a derivative rather than a fundamental matter. Nevertheless, neither of these considerations should lead us to believe that there are no such things as the shapes of worms. If we accept that worms can have shape properties, the natural assumption is that these shape properties obey SL, so that the shape of the location of the worm is the same as the shape of the worm. The worm of a fundamental particle is long and thin; so too is its location. The worm of the MCG is shorter and fatter; so too is its location.

The same intuitions support the thought that, if their distinctness is accepted, Abel's worm is shorter and wider than Adam's worm, and the mereological theory discussed in the present section permits that. If we accept SL, the location of Abel's worm should be shorter and wider than the shape of Adam's worm. Purely extensional fusion of S-regions won't allow these distinctions, but the non-extensional conception of locations developed in this section does allow these distinctions. So if we agree that the four-dimensional shapes of distinct objects should be reflected in the shapes of the locations they occupy, and we accept the different shapes of Abel and Adam, then a non-extensional fusion

³⁹If shape is intrinsic: see Skow 2007.

of the distinct S-regions of these objects is required. This argument doesn't support an exact mirroring of the mereological structure of objects and regions; it concludes that when we have fairly robust intuitions about the structure of an object, the location of that object should have a structure rich enough to capture those intuitions in line with SL.

This response to the spacetime worry could be turned around. The principles of Mereological Harmony and SL are not dependent on MM, and if one is worried (as I am) by the excessive multiplication of spacetime regions MM induces, one could use these principles to argue that an extensional mereology must also be the correct mereology for continuants—as argued in section 5.2.

The Overgeneration Worry The overgeneration worry is equally simple. Because there are many sequences that can be formed from the same elements, there will be intuitively too many fusions of a single collection of parts. We were able in the case of Adam to select a 'natural' fusion, the sequence ordered by personal time. But all the other possible sequences are fusions of those parts too, and they equally exist. Perhaps there is in this case only one plausible candidate fusion to be the continuant Adam, and we can appeal to pragmatic factors to explain why we ignore all the other relatively unnatural fusions. (In much the same way as believers in unrestricted composition defend that doctrine from the objection that it commits us to the existence of too many things, like Lewis 1991: 79–81.) But the case of Abel shows that this does not eliminate all the problems, since there will be many equally good fusions of simultaneous parts, none of which is more natural than any other (in the absence of any natural 'order' on points of space).

The natural way to try and cut down on these additional spurious entities is to try to strengthen MM; but, as I mentioned earlier, many natural strengthenings collapse into extensional mereology. We could mark a distinction between

temporal and spatial parts, perhaps treating spatial fusions extensionally and temporal fusions non-extensionally, but this undermines one strong motivation for perdurantism from perceived analogies between spatial and temporal features of objects.

Finally, we might try to impose additional non-mereological constraints, just as we did when we chose the ‘natural’ ordering by personal time for Adam. Even if this move works in the case of Adam, I have no idea what kind of genuinely objective constraint would prefer one of the two alternative sequences $\langle a, b \rangle$ and $\langle b, a \rangle$ made from the parts $\langle a \rangle$ and $\langle b \rangle$. But there is also considerable reason for worry in the case of Adam. The relevant non-mereological principle there is something like this:

***F*-Fusion** There exists a fusion of some things just in case those things are an *F* or can be unified by same-*F*-as relation over personal time.

In this case, we get Adam, because those parts stand in the same-atom-as relation over personal time. But since the notion of personal time makes no sense for spacetime regions, which cannot time-travel, the *F*-Fusion principle will not allow us to form a fusion of the locations of Adam’s temporal parts that orders them other than in external time—that is, the only fusion that exists that is at all a candidate for Adam’s location is Abel’s location, and we get coincidence again. Cutting down on the number of continuants by appeal to non-mereological principles will very likely rule out almost all of the locations needed to avoid coincidence.

Nothing in the present section has made any real headway against the arguments of section 5 against the distinctness of Adam and Abel. So all those reasons to explain away the intuitive pull of distinctness need to be undermined, if we are to take the radical step of adopting a non-extensional mereology. Perhaps non-extensional mereologies are appropriate for endurantists, but there is

a strong case to be made that perdurantism most naturally combines with classical extensional mereology—particularly because, for example, in some cases anti-endurantist arguments rely on there being a unique location for every spacetime region.⁴⁰ That said, the aim of the present section was merely to indicate that, even if a perdurantist was so swayed by the intuition of distinctness that they accept that Abel is not Adam, there are somewhat plausible responses that can be made which avoid Gilmore’s conclusions.

7 Conclusion

While Gilmore’s cases are ingenious and interesting, once we pay careful attention to the theory of location and the mereological structure of the cases, there is no reason for an orthodox perdurantist, who accepts classical extensional mereology and the view that paths are locations, to be worried by Gilmore’s cases. Even a non-standard perdurantist, who believes in the distinctness of the objects concerned and hence accepts non-standard mereology, can respond to Gilmore’s cases by adopting that perfectly reasonable view that the mereological relations on locations mimic those of the objects which have those locations. Neither of these options undermines all common anti-endurantist arguments (though the view of section 6 does worse on this score). The first doesn’t even involve any modification to the express published views of standard perdurantists. Either way it is clear that there remains an asymmetry here: while endurantists fail to respond to apparent coincidence in some orthodox cases of objects with overlapping stages, the perdurantist is able to, and, orthodox or not, faces no related problem from Gilmore’s more *recherché* cases. Orthodox perdurantism moreover remains the best unified account of the paradoxes of coincidence.⁴¹

⁴⁰For example, an endurantist could respond to the case of Deon and Theon by multiplying locations corresponding to the spacetime region where both are to be found.

⁴¹For discussion and comments, thanks to audiences at a meeting of the BSPPS and at the Universities of Notre Dame, Nottingham, and Oxford, and to Cody Gilmore, Ben Caplan,

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