6. Time Travel, Coinciding Objects, and Persistence

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1. INTRODUCTION

Endurantism, roughly stated, is the view that material objects lack temporal extent and persist through time by 'enduring'—that is, by being *wholly present* at each moment of their careers. Perdurantism is the opposing view that material objects persist by 'perduring'—that is, by being temporally extended and having different *temporal parts* located at different times.[1] In this paper I offer an argument against perdurantism, one based largely on premises that have been used in arguments against endurantism. Perdurantists can resist the argument, but not, I think, without weakening at least one of the relevant anti-endurantist arguments.[2] In one way or another, then, this chapter is meant to alter the overall debate between endurantists and perdurantists to the benefit of the former.

The heart of the chapter is the presentation of a new type of coincidence puzzle. A coincidence puzzle is an apparent counter-example to the following, widely accepted *anti-coincidence principle*:

[1] This usage of the terms 'endure' and 'perdure' is due to Mark Johnston (1983). Both endurantism and perdurantism should be distinguished from the *stage* view (e.g. Sider 2001, Hawley 2001), which differs from standard perdurantism in identifying ordinary material objects, not with temporally extended sums of temporal parts (worms) as perdurantists do, but with so-called 'stages'—i.e. with the entities that perdurantists call 'instantaneous temporal parts of ordinary material objects'. Stage theorists need not and typically do not deny the existence of worms; rather, they merely deny that tables and human beings and other ordinary things are worms. The argument presented in this chapter is not intended to count against the stage view; and I shall ignore it in what follows. (For discussion and criticism of the view, see Haslanger 2003, who dubs it 'exdurantism'.)

[2] One such anti-endurantist argument is Theodore Sider's argument from time travel (2001: 101–9). For further discussion of Sider's argument, see Davidson (2004), Markosian (2004), and Sider (2004).

> It is impossible for numerically distinct material objects to *coincide*—that is, to be (i) wholly present in exactly the same location[3] and (ii) composed, at some level of decomposition, of all the same parts or all the same matter at the given location.[4]

To *solve* such a puzzle, as I shall use the term, is to show that the case in question does not in fact constitute a genuine counter-example to the principle.[5]

Existing coincidence puzzles can be divided into two types, corresponding to the manner in which they bear upon the endurantism v. perdurantism debate. Puzzles of the first type (involving temporary spatial co-location) can be solved simply by abandoning endurantism in favor of perdurantism, whereas those of the second type (involving career-long spatial co-location) remain equally puzzling on both views. In this paper I show that if backward time travel is possible, then a *third* type of coincidence puzzle arises. Puzzles of this third type confront perdurantists and can be solved simply by shifting to endurantism.

The plan for the chapter is as follows. In Section 2 I introduce some new terminology and show how it applies to the older puzzles. In Section 3 I give two examples of the new type of puzzle. Finally, in Section 4, I present the argument against perdurantism and discuss a number of possible responses.

[3] That is, same spacetime region or same place at one time.

[4] This is a rough statement of the principle. To state the principle in a way that would make it both maximally precise and acceptable to all self-described anti-coincidentalists (who disagree amongst themselves as to (i) the adicity of the fundamental parthood relation and (ii) the definability of the three-place relation in terms of the two-place notion, and vice versa), we would need to make the principle highly disjunctive and conditional. In my opinion, it is not especially difficult to formulate such a principle, but it is tedious and the results are difficult to process at a glance. Since the principle would require so much unpacking and the benefits of seeing it written out are minimal, I will not formulate it here.

Moreover, for the sake of brevity, I shall henceforth speak of coincidence as if it involved nothing more than sharing the same location. Nothing will turn on this: for each of the examples that I shall discuss, it will be obvious that if the relevant objects *share the same location*, then they also *share all the same parts or all the same matter at that location*. (None is merely a case of co-location without matter-sharing—e.g. a case in which two 'ghost' particles freely pass through one another without ever sharing parts or matter. Even died-in-the-wool anti-coincidentalists can happily concede the possibility of ghost particles.)

[5] Another sort of solution, of course, is simply to reject the anti-coincidence principle itself (e.g. Johnston 1992, Fine 2003). I do not wish to suggest that I endorse the principle. For ease of exposition, however, I shall speak in the manner indicated above.

2. NEW TERMINOLOGY AND ITS APPLICATION TO EXISTING PUZZLES

I shall begin by introducing three technical terms. (1) Let us say that spacetime region[6] R is a *location* of object O just in case R exactly contains the whole of O, or, synonymously, just in case O *exactly occupies*[7] or is *wholly present* at R. (2) Let us say that spacetime region R is an *S-region* of object O just in case R corresponds to what we would ordinarily think of as a spatial location of O at some instant in O's career.[8] Only instantaneous spacetime regions can be S-regions of objects. (3) Let us say that spacetime region R is the *path* of object O just in case R is the union of the regions that O exactly occupies. (This entails that if O occupies just one region, then *that* region is O's path.) Intuitively, an object's path is the spacetime region that exactly corresponds to O's complete career or life-history. This will always be the union of the object's S-regions.

Given a complete description of the career of some material object O, philosophers on both sides of the endurance v. perdurance dispute can all agree on two things: they can all agree about which region is O's *path*, and they can all agree about which regions are O's *S-regions*.

[6] Throughout this chapter I presuppose that some form of spacetime substantivalism is true.

[7] Let me say a brief word about my understanding of the notion of being *wholly present* at, or *exactly occupying*, a region. (I use these phrases interchangeably, although I am aware than not everyone will approve of this policy.) I take no stand on the question of whether this notion is primitive or defined, but do not attempt to define it here. I assume that it can be partially characterized by the following principle: (1) necessarily, if entity O exactly occupies spacetime region R, then O has, or has-at-R, the same shape and size as R, and O stands, or stands-at-R, in the same spatiotemporal relations to things as does R. It also seems plausible to suppose that exact occupation obeys a second principle: (2) necessarily, if O is a material object and O exactly occupies each of two distinct spacetime regions R and R*, then some sort of immanent causal relation holds between the contents of R and the contents of R*. I assume that there is nothing obviously false or unintelligible about the claim that a single thing exactly occupies each of several non-intersecting, extended regions but not their union or any of their proper subregions. Once the notion of exact occupation is understood, it can be used to define other, arguably less fundamental, locative notions. For example, 'Spacetime point p *lies within* object O' can be defined as 'p belongs to some region that O exactly occupies', and Josh Parsons's 'x is weakly located at R' (Chapter 7) can be defined as 'x exactly occupies some region that intersects R'. For a fuller characterization of exact occupation and other definitions, see my 2006.

[8] Some may find the following, alternative characterization helpful: R is an S-region of O just in case R is a region that O would exactly occupy if O were an enduring object.

What these philosophers *disagree* about is which regions are O's *locations*. Perdurantists will say that O has only one location[9]—namely, its path—and that none of O's S-regions are locations of O. Endurantists will say that O has many locations—namely, its S-regions—and that O's path is not a location of O.[10]

These terms provide us with a convenient method of classifying coincidence puzzles, both old and new. We can divide the old puzzles into two types. We shall say that O and O* are involved in a *type A situation* just in case: (i) O and O* are numerically distinct material objects, (ii) they share one or more of their S-regions, and (iii) they have different paths. And we shall say that O and O* are involved in a *type B situation* just in case: (i) O and O* are numerically distinct material objects, (ii) they have all of their S-regions in common, and (iii) they share the same path. The objects involved in a type A situation are spatially co-located for at least one instant but do not have perfectly coextensive life-histories. The objects involved in a type B situation are spatially co-located with each other throughout their careers, from which it follows that they do have perfectly coextensive life-histories.

The possibility of type A situations would force the endurantist, but not the perdurantist, to accept the possibility of distinct, coinciding material objects. To see this, suppose that Dion and Theon[11] are involved in such a situation, that is, that they are distinct material objects that share some of their S-regions but don't have the same total path.

[9] So far as I am aware, Hudson (2001) is the only self-described perdurantist who denies this. On his view, ordinary things such as human beings are multi-located space-time worms, wholly present at each of many, massively overlapping, four-dimensional spacetime regions.

[10] I suspect that some self-described endurantists, especially Josh Parsons (2000 and ch. 7), would balk at this. (According to Parsons, fundamental particles such as quarks are spatially and temporally extended mereological simples. Parsons counts them as endurers merely because they lack proper temporal parts. Moreover, he defines a notion of being wholly located at a region according to which it is analytic truth that an extended simple is wholly located at each of many regions—specifically, at each of the many subregions of that region containing all and only those points that lie within the simple. So I suspect that Parsons would say that a quark is wholly located at each point in its path, not just at its S-regions.) It seems to me, however, that endurantists *ought* to accept the words that I've put in their mouths and that the vast majority of them *would* accept this if they were to consider the matter in these terms.

[11] Dion is a man who loses his left foot at t. Theon is the large part of Dion that, prior to t, consists of all of Dion but his left foot. Assuming that they both exist before and after the amputation, it seems that Dion and Theon share their *post*-t S-regions but have different (though overlapping) *pre*-t S-regions.

Then, like any pair of objects involved in a type A situation, Dion and Theon will coincide if they endure but not if they perdure. If they *endure*, then each of them is wholly present in each of its S-regions. Since they have at least one S-region in common, there is at least one spacetime region at which they are both wholly present, that is, at which they coincide. If, on the other hand, Dion and Theon *perdure*, then each of them is wholly present only at its own path. And since they do not share a path, there is no spacetime region at which they coincide. This shows that type A situations constitute coincidence puzzles that can be solved simply by abandoning endurantism in favor of perdurantism.

The possibility of type B situations, on the other hand, would force both the endurantist and the perdurantist to accept the possibility of distinct, coinciding material objects.[12] This can be seen by supposing that Lumpl and Goliath[13] are involved in such a situation, that is, that they are distinct material objects that share all of their S-regions and their path. Like any such pair, they will coincide *not only* if they endure, but also if they perdure. If they endure, they coincide at each of their many shared S-regions; if they perdure, they coincide at their one shared path. And of course the point is completely general: type B situations, were they to occur, would constitute coincidence puzzles that would remain *equally* puzzling regardless of which of the two rival views about persistence is correct.

3. THE NEW PUZZLES

So much for existing puzzles; I shall now describe a new type of puzzle. Let us say that O and O* are involved in a *type C situation* just in case: (i) O and O* are numerically distinct material objects, (ii) they have *none* of

[12] According to my definition of 'type B situation', O and O* must be numerically distinct in order to be involved in such a situation. So far as I am aware, all actual perdurantists accept the anti-coincidence principle and so deny the possibility of type B situations. Perdurantists differ amongst themselves as to the best technique for explaining away the apparent differences between the objects that seem to be involved in such situations. See, e.g. Lewis (1971), Gibbard (1975), Heller (1990), and Noonan (1993).

[13] Following Gibbard (1975), we can suppose that Lumpl is a statue-shaped lump of clay, that Goliath is a clay statue, that Lumpl and Goliath are created at the same time and destroyed at the same time, and that they share their constituent matter throughout their lives. Of course, Gibbard himself would deny that Lumpl and Goliath are distinct and so would deny that they're involved in a *type B situation*, given my definition of this term.

their S-regions in common, and (iii) they share the same path. The objects involved in a type C situation are never spatially co-located despite the fact that they trace out the same overall path through space-time. I shall present two apparent examples of this type of situation.

The first case involves a form of backward time travel that is familiar from science fiction stories but receives little serious attention from physicists or philosophers of science. The idea is that something persists through time in the normal way for a while then suddenly disappears, reappearing out of nowhere at an earlier time.[14] We are supposed to think of the time-traveler as jumping discontinuously from the later time to the earlier time, rather than gradually and continuously working his way back.

Suppose that some cell is originally created at the beginning of the year 2000 and that it jumps back in time over and over again, never venturing further back in time than the moment of its original creation, and never progressing beyond the 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,[15] 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, one who exhibits the strange behavior of living in my bathtub, and whose constituent cells seem to pop into and out of existence,[16] but who is otherwise quite normal.

[14] This description of the situation presupposes that we can make out some distinction between external time and the time-traveler's proper (or personal) time, so that whereas the reappearance precedes the disappearance in external time, the order of these events is reversed with respect to the time traveler's proper time. Intuitively, external time corresponds to the prevailing global time order, whereas a thing's proper time is what would be measured by a clock carried along with that thing. For more on this distinction, see Lewis (1976).

[15] Plausibly, Cell counts as a backward time traveler only if his sudden disappearances *cause* his earlier reappearances. To ensure that even a Humean about causation will have grounds for holding that for each sudden *disappearance* D of Cell, D causes some specific *reappearance* R of Cell at an earlier time, we may need to supplement the case as follows: let Cell contain a tiny clock that measures the elapse of Cell's proper (or personal) time and that never returns to the same state. Then a given disappearance D will count as the cause of an earlier reappearance R provided that the clock's state at R indicates that R occurs immediately after D (with respect to Cell's proper time).

[16] As I envision the situation, there are many appearances and disappearances of Cell occurring throughout Tubman's life, at various places within his body.

Let us use the name 'Cell' to refer to the time-traveling cell involved in this case, and let us use the name 'Tubman' to refer to the macroscopic object that is completely composed by Cell throughout the three-year interval. Cell and Tubman trace out the same overall spacetime path over the course of their careers. But, intuitively speaking, they do so in different ways, for their S-regions are quite different. At each moment in the interval in question, Tubman has exactly one spatial location, this location being human-sized and human-shaped. Cell, however, has a great many different spatial locations at each moment in this interval, each of these locations being microscopic and cell-shaped.

The fact that Cell and Tubman have different S-regions entails that they are numerically distinct. However, their distinctness can be argued for in other ways as well. (1) Tubman is conscious, but Cell is not.[17] (2) Unlike Cell, Tubman will never travel backward in time. No one will ever see older and younger versions of him in the same room at once. Thus the case of Cell and Tubman seems to be an example of a type C situation: it seems to involve distinct material objects that share their path but have none of their S-regions in common.[18]

Like any pair of objects involved in such a situation, Cell and Tubman coincide if they perdure but not if they endure. If they perdure, then each of them is singly located: each of them is wholly present only at its

[17] Indeed, we might imagine a variant of this case in which: (i) Cell is replaced by Happy, a tiny sentient creature who is always elated, and (ii) Tubman is replaced by Sad, a macroscopic creature who is depressed throughout his life. Though Happy and Sad share a path, the apparent incompatibility of their mental histories strongly suggests that they're distinct.

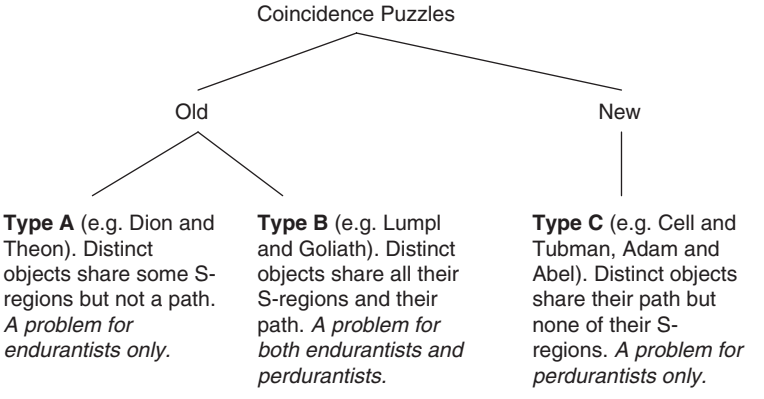
[18] It is worthwhile to contrast the way in which these objects differ from the way in which the objects involved in familiar type B cases (or 'alleged' type B cases) differ. Whereas the latter objects typically differ only with respect to their modal properties, persistence conditions, or sorts, the former objects differ with regard to straightforward physical properties (mass, spatial location, spatial size) and mental properties. Fine (2003) has noted that objects apparently involved in type B situations sometimes seem to differ with respect to not-obviously-modal properties such as *being valuable* or *being damaged*. (A bronze statue, e.g. may be left undamaged by irradiation that damages its constituent piece of bronze.) It seems to me, however, that these differences are in some way *social* or *institutional* and therefore depend on the existence of sentient beings (which, of course, does not by itself entail that these differences are unreal), whereas some of the differences between the objects in my type C cases do not so depend. Thus even if, for some as-yet-unspecified reason, one is inclined to reject arguments for non-identity based on supposed differences with respect to modal properties, persistence conditions, sorts, or properties such as *being valuable* and *being damaged*, one can *still* accept my argument for the non-identity of Cell and Tubman.

entire path. And since they both have the *same* path, they coincide there. If they endure, however, then each of them is multi-located: each of them is wholly present at each of its S-regions (and at those regions only[19]). But since they have *none* of their S-regions in common, there is no spacetime region at which they are both wholly present; that is, they do not coincide anywhere. Rather, Cell is wholly present only at many microscopic, cell-shaped, instantaneous spacetime regions, while Tubman is wholly present only at many macroscopic, human-shaped, instantaneous spacetime regions.

Thus type C situations constitute coincidence puzzles that can be solved simply by shifting from perdurantism to endurantism.[20] The possibility of such situations would force the perdurantist, but not the endurantist, to accept the possibility of distinct, coinciding material objects.

[19] Why shouldn't the endurantist say that Cell is also wholly present at many macroscopic, human-shaped regions, in addition to being wholly present at many microscopic, cell-shaped regions? For at least three reasons: (1) If the endurantist were to say this, he would be admitting that both Cell and Tubman are wholly present at each of the relevant human-shaped regions, hence that they coincide at those regions. Thus endurantism would no longer solve the puzzle in question. (2) As I mentioned in a previous note, being wholly present in a region entails having (at that region) the same shape and size as that region. So if the endurantist were to say that Cell is wholly present at many macroscopic, human-shaped regions, he would be committed to the implausible view that Cell, a mere human cell, is human-sized and human-shaped (at certain regions). (3) Assume endurantism is true. We know, then, that Cell's career begins in some small, cell-shaped region; call it R. (Perhaps Cell has no *first* S-region; still, we know there's some brief series of such regions where Cell's career begins.) So we know that Cell is wholly present at R (or at each member of the series). We also know, it seems to me, that if a material object is wholly present at each of two different regions, R and R*, then there must be the appropriate sort of immanent causal relation between R and R* (or their 'contents'). But the small, cell-shaped region R, it seems, does not bear the right sort of immanent causal relation to any large, human-shaped region. (Alternatively: no member of the relevant series bears such a relation.) R bears the sufficiently intimate sorts of causal relations *only to other small regions*, in my view. So no material object that is wholly present at R is also wholly present at any large, human-shaped spacetime region.

[20] The endurantist solution to type C puzzles avoids coincidence (or co-location) by embracing multi-location. It might be argued, however, that multi-location is no less puzzling than co-location, at least when we're talking about *spatial* multi-location, in which a single thing is wholly present at two different places at one time, or in two different instantaneous spacetime regions that belong to a single ''simultaneity-slice'' or spacelike hypersurface. Since I have defended multi-location in detail elsewhere (2003), I will not address the above objection at length here. I would, however, like to make two brief points. (1) It seems to me that we can account for the initial plausibility of the ban on spatial multi-location, while allowing for the possibility of exceptions to this ban, in the following manner. First, we note the plausibility of the principle that a single material



I shall now present a second, physically more plausible, example of a type C situation. The General Theory of Relativity (GTR) permits the occurrence of what physicists call *closed timelike curves* (Gödel 1949), or *CTC*s. A timelike curve is a continuous path through spacetime corresponding to the possible life-history of a particle with mass. Unlike our time-traveling cell, a particle whose path is a timelike curve is ''always oriented towards [its] local future'':[21] at no point in its career does the object travel backward in time with respect to its immediate neighborhood in spacetime. A timelike curve is *closed* just in case it forms a loop, thus ''ending where it began'', so to speak. A particle that

object can be wholly present in two different spacetime regions only if the appropriate sort of immanent causal relation holds between the contents of those regions. Next, we note that only in the most bizarre circumstances could the relevant sort of causal relation hold between the contents of distinct but simultaneous spacetime regions. Hence, in the absence of such bizarre circumstances, spatially multi-located material objects are impossible, as many people normally assume. However, the time travel situations that I am now considering provide exactly the bizarre sorts of circumstances needed for the relevant type of causal relations to hold between simultaneous spacetime regions and hence for spatially multi-located material objects. (2) Objection: a spatially multi-located material object might have contrary properties at a single time. e.g. it might be that the whole of O is hot (over here) and, at the same time, the whole of O is cold (over there). But it's impossible for the whole of a thing to be both hot and cold at the same time. Reply: O bears the hot-at relation to spacetime region R (or to a moment pt of O's proper time at which O is wholly present at R) and O bears the cold-at relation to the different (but simultaneous) spacetime region R* (or to a moment pt* ($\neq$ pt) of O's proper time at which O is wholly present at R*). Alternatively, a similar relativizing treatment can be given, not to the variable properties (hotness and coldness), but the instantiation relation. For further defenses of multi-location, see McDaniel (2003) and Beebee and Rush (2003).

[21] In the words of Smith (1998).

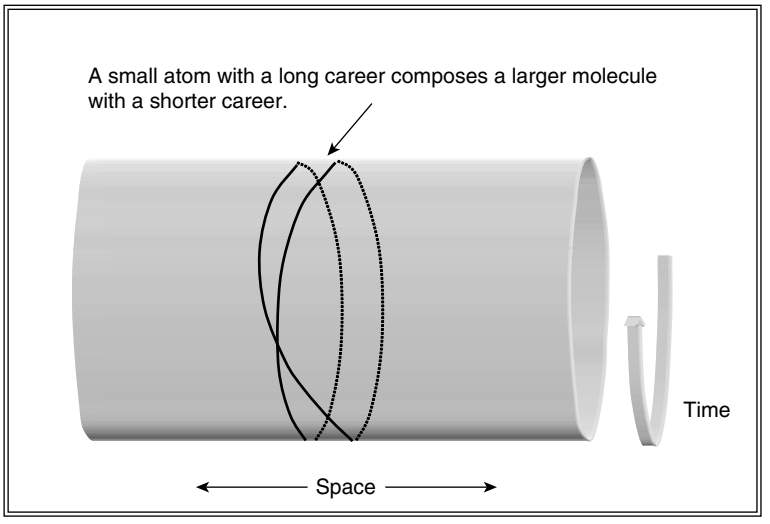


Figure 6.1 Time travel via a CTC in cylindrical spacetime

traces out an *almost* closed timelike curve would, just by lasting long enough and taking the appropriate trajectory, return to its own past and coexist with a younger version of itself.

Since the original discovery that GTR permits CTCs, physicists and philosophers have noted that similar time-travel scenarios can be constructed in the Minkowski spacetime of the Special Theory of Relativity and even in the pre-relativistic contexts of Newtonian and neo-Newtonian spacetime. We need only suppose that the relevant spacetimes could be 'cylindrical', with a closed, circular, temporal dimension.[22]

Consider the path in Figure 6.1, and suppose that it represents the career of a hydrogen atom, which we shall call 'Adam'. Adam is spatially bi-located throughout 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': that is, 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

[22] See, e.g. Weingard (1979: 207), Horwich (1987), Earman (1995).

throughout its career (which is only one billion years long). For any given external time t, Abel is present at t only once: that is, there is only *one* moment of Abel's proper time at which Abel is present at t.

The case of Adam and Abel seems to be a type C situation. These objects trace out the same path over the course of their careers, but they are never spatially co-located. In particular, each of Adam's S-regions is smaller than any of Abel's S-regions. These objects share their path but none of their S-regions. The fact that they have different S-regions entails that they are distinct. But, as in the previous case, the distinctness of Adam and Abel can be argued for in a number of ways. Adam, being a mere hydrogen atom, has certain chemical properties that Abel lacks. Abel, being a hydrogen molecule, is more massive than Adam.[23]

This last point deserves elaboration. Let us think of a *mass history* as a certain sort of property of a material object, a property that reflects the way in which the object's mass changes, or stays constant, over the course of its career. Mass histories can be more or less specific. The following property, for example, is a fairly specific mass history:

> *being an object that has a rest mass of 10 units throughout the first ten years of its career, then gradually increases in mass for the next five years until it attains a rest mass of 20 units, at which point its rest mass remains constant for the final three years of its career.*

Here are two more mass histories, the first instantiated by Adam, the second by Abel.

MH1 *being an object that has a rest mass of 1 unit throughout its 2-billion-year-long career.*

MH2 *being an object that has a rest mass of more than one unit throughout its 1-billion-year-long career.*

Mass histories MH1 and MH2 are, of course, quite different: MH1 is characteristic of a hydrogen atom, whereas MH2 is characteristic of a molecule of H_2.

MH1 and MH2 seem to be incompatible intrinsic properties. Each seems to be *intrinsic* in the sense (roughly stated) that whether or not a

[23] We can imagine a variant of this case in which Adam is replaced by a small, long-lived sentient being who is elated throughout its life, and Abel is replaced by a larger, shorter-lived sentient being who is depressed throughout its life. The apparent incompatibility of these mental histories would seem to show that the creatures are distinct.

thing has the property depends only on what the thing is like in itself, and is independent of how that thing is related to anything else. They seem to be *incompatible* in the sense that it's impossible for a single thing to have both of them. Moreover, these properties seem to be purely physical, non-modal, and mind-independent. The fact that Adam has MH1 and Abel has MH2 would, therefore, seem to provide a very firm basis for the conclusion that Adam $\neq$ Abel. The force of this argument ought to be acknowledged by an extremely wide range of philosophers.

4. AN ARGUMENT AGAINST PERDURANTISM, AND SOME RESPONSES

Confronted with the puzzles that I have described, perdurantists have a number of options. To present these options, it will be useful to have my anti-perdurantist argument set out in numbered form:

P1 Type C situations are possible: there are possible worlds in which they occur.
P2 For any possible world w, if a type C situation occurs in w, then either: (i) there are numerically distinct material objects that coincide in w (in which case the anti-coincidence principle is false) or (ii) perdurantism is not true in w.
P3 The anti-coincidence principle is true: it is *impossible* for numerically distinct material objects to coincide.
C1 Perdurantism is not a necessary truth: there are possible worlds in which it is not true. (P1, P2, P3)
P4 Perdurantism, like endurantism, is either necessarily true or necessarily false.
C2 Perdurantism is necessarily false. (C1, P4)

As I noted at the beginning of the chapter, there are various ways in which the perdurantist can resist this argument. Each of these options, however, would significantly weaken at least one well-known anti-endurantist argument. Or so I shall now try to show.

First option. The perdurantist can deny P4 and hold, with David Lewis (1999: 227), that perdurantism is a contingent truth. Such a perdurantist could say that there are possible worlds at which type C situations occur and that perdurantism is false at such worlds. He could go on to say that

perdurantism remains true in the actual world, which does not (so far as we know!) contain any type C situations.

I am not entirely hostile to this response. First, it concedes most of what I have attempted to show in this chapter—namely, that there is a third and heretofore unnoticed type of coincidence situation, a type whose occurrence is compatible with endurantism but not with perdurantism (given the anti-coincidence principle).

Secondly, this response undermines all anti-endurantist arguments that rely on P4 (or something relevantly like it). One such argument is Theodore Sider's time-travel-based argument against endurantism (2001: 101–9). Sider tries to show that

(S) endurantism is false in worlds in which certain sorts of time travel occur.

But of course (S) by itself does not entail that

(T) endurantism is false in the *actual* world (where, so far as we know, the relevant sort of time travel does not occur).

As Sider is well aware, the move from (S) to (T) requires an additional assumption. Either (A1) or (A2) would do the necessary work:

(A1) a theory of persistence (such as endurantism or perdurantism) is false in the actual world if it is false in any possible world, or

(A2) it's true both that:

(i) a theory of persistence is false in the actual world if it is false in any possible world w that is governed by the same laws of nature as the actual world, and that

(ii) the relevant sorts of time travel are nomically possible: they occur at possible worlds that are governed by the same laws of nature as is the actual world.[24]

But any principle that could license Sider's inference from (S) to (T) would also, it seems, license the corresponding inference in my argument.[25] In other words, any such principle will be capable of playing the

[24] Gödel (1949) relies on a premise closely analogous to (A2) in his argument for the unreality of time. For insightful discussion of Gödel's argument, see Savitt (1994), Earman (1995), and Yourgrau (1999).

[25] Provided that it is stated as constraint on *any* theory of persistence, not merely as a special constraint upon endurantism. If it's stated in the latter fashion, then it will be plausible only to the extent that a corresponding constraint upon perdurantism is also plausible.

role of P4.[26] I conclude, therefore, that the perdurantist who blocks my argument by rejecting P4 (and its potential substitutes) thereby undermines Sider's time-travel-based argument against endurantism. While some of Sider's anti-endurantist allies might see this as a small price to pay, Sider himself rates the argument from time travel as one of the weightiest considerations against endurantism, ahead, for example, of Lewis's argument from temporary intrinsics (of which more later) and various arguments from relativity theory.

Second option. The perdurantist can deny P3 and hold that it's possible for two different material objects to coincide—that is, to exactly occupy the very same location and to be composed of the very same particles or matter at that location. This option, however, undermines all anti-endurantist arguments that depend upon the truth of P3, including Mark Heller's influential ''Body/Body-minus'' argument (1984). (Heller argues, roughly, that since the anti-coincidence principle is true, and since type A situations violate this principle given endurantism but not given perdurantism, the latter view must be correct.[27])

Third option. Perdurantists can deny the possibility of backward time travel[28] and with it the possibility of type C situations, which necessarily involve such time travel. This would allow perdurantists to reject P1. This third option has two strikes against it. First, it's implausible: the

[26] Consider (A1). Just as (A1) would allow Sider to derive the actual falsehood of endurantism from its possible falsehood, this assumption would allow me to derive the actual falsehood of perdurantism from its possible falsehood. Next consider (A2). It says (i) that if a theory of persistence is false at some nomically possible world, then it's false at the actual world and (ii) that the sorts of time travel situations that Sider takes to be incompatible with endurantism occur at nomically possible worlds. This would of course allow Sider to derive the actual falsehood of endurantism from its falsehood at the relevant time travel worlds; and it would allow me to derive the actual falsehood of perdurantism from its falsehood at the given worlds.

[27] Heller and his allies might reply by claiming that his argument relies not on the anti-coincidence principle (according to which coincidence is *impossible*) but on the weaker principle that distinct material objects do not *actually* coincide. Even this weaker principle (the reply continues) is enough to show that endurantism is false given something that many will grant—namely, the *actual* occurrence of a type A situation. In response, I shall content myself with the following point. It is unclear what motivation one could possibly have for holding the weaker principle but not the stronger. If one concedes that distinct material objects *can* coincide, and even that they do so in worlds governed by the same laws of nature as our own, why think that they don't *actually* coincide? This point seems sufficient to establish that, the above reply notwithstanding, the perdurantist who takes the ''second option'' thereby significantly weakens Heller's Body/Body-minus argument.

[28] Both via CTCs and via discontinuous jumps.

case in favor of the metaphysical possibility of backward time travel, even of the ''Wellsian'' variety involved in the Cell–Tubman example, is quite forceful.[29] An even more powerful case can be made for the ''Gödelian'' time travel involved in the Adam–Abel example, which seems to be not just metaphysically but also nomically possible.[30] Secondly, denying the possibility of backward time travel (like denying P4) would obviously undermine Sider's time-travel-based argument against endurantism.

Fourth option. Perdurantists can adopt an eliminativist view about composite material objects[31] and deny the possibility of composites like Tubman and Abel, composites that would—if they existed—have the same paths as the smaller, longer-lived objects that seem to compose them.[32] Like the third option, this would allow perdurantists to deny P1: whenever we may *seem* to have a larger object and a smaller object

[29] See, e.g. Lewis (1976) and Sider (2002).

[30] See, e.g. Horwich (1975), Weingard (1979), Earman (1995), and Smith (1998). The terms 'Wellsian' and 'Gödelian' are due to Earman.

[31] For a non-dismissive discussion of such a view, see Rosen and Dorr (2002).

[32] As Kris McDaniel has noted, it might be argued that composites such as Abel and Tubman are on worse footing than composites generally, since it may seem that the former objects but not the latter objects would violate the widely accepted mereological principle ('weak supplementation') that if a thing has a proper part, then it has another proper part that shares no part with the first. It may seem that all of Abel's parts share parts with Adam. In my view, the best response to this problem is to hold that the fundamental parthood relation is neither the two-place relation 'x is part of y' nor the three-place relation 'x is part of y at time t' but rather is the four-place relation 'x, at moment t_x of its proper time, is part of y, at moment t_y of its proper time'. Traditional formal theories of the part–whole relation assume that parthood is the two-place relation. Those who hold that parthood is three-place and temporally relativized can, however, formulate various analogues of the familiar principles of traditional mereological systems. Thus, e.g. the transitivity principle of traditional theories can be restated as: (T*) for any objects x, y, and z and time t, if x is part of y at t and y is part of z at t, then x is part of z at t. (The traditional principle has other, less plausible, analogues as well.) Similarly, if we assume that parthood is four-place, we can formulate various analogues of the principles stated in terms of two- or three-place parthood. The strongest plausible analogue of (T*) is: (T**) for any object x and moment of its proper time t_x, any object y and moment of its proper time t_y, and any object z and moment of its proper time t_z, if x at t_x is part of y at t_y and y at t_y is part of z at t_z, then x at t_x is part of z at t_z. What, then, of weak supplementation? Here is the strongest four-place analogue of that principle that all of my cases respect: (S**) for any object x and moment of its proper time t_x and any object y and moment of its proper time t_y, if [x at t_x is part of y at t_y and either ($x \neq y$ or $t_x \neq t_y$)], then there is some object z and moment of its proper time t_z such that: (i) z at t_z is part of y at t_y, (ii) either $z \neq y$ or $t_z \neq t_y$, (iii) either $z \neq x$ or $t_z \neq t_x$, and (iv) it's not the case that there's some object u and moment t_u of its proper time such that (a) u at t_u is part of x at t_x and (b) u at t_u is part of z at t_z. (The analogy may be easier to see if one notes that ordered

involved in a type C situation, we *in fact* have only the smaller object (if we have even that much).

Also like the third option, this fourth option has two strikes against it. First—and for what it's worth—this option is at least somewhat counterintuitive: when we have many particles arranged 'human-wise', it does intuitively seem that these particles compose a human being (or at least a humanoid); and when we have quarks and electrons arranged 'hydrogen molecule-wise', it intuitively seems that these particles compose a hydrogen molecule. The second strike against option four, from the point of view of perdurantism, is that it would significantly weaken Heller's Body/Body-minus argument against endurantism, which assumes that this sort of eliminativism is unacceptable as a solution to type A puzzles. (Sider's argument from vagueness (1997, 2001, forthcoming) against endurantism also conflicts with this eliminativist position.)

Fifth option. Perdurantists can hold that, despite the apparent differences between them, Adam and Abel are in fact numerically one and the same thing, and so too for Cell and Tubman. Like the two previous options, this fifth option would allow the perdurantist to reject P1 and deny the possibility of genuine type C situations (which by definition involve numerically distinct objects).

I argued, recall, that Adam and Abel have incompatible mass histories—that Adam has MH1 whereas Abel has MH2. Since it's impossible for a single thing to have incompatible properties, I concluded that Adam and Abel were distinct. Perdurantists, however, might respond as follows.

The thing that we're calling 'Adam' can be exhaustively partitioned into instantaneous temporal parts in different ways. On one way of being partitioned—call it the 'atomish' way—each of the relevant parts has the size, shape, and mass of a hydrogen atom. On a different way of being partitioned into instantaneous temporal parts—call it the 'moleculean' way—each of the relevant parts has the size, shape, and mass of a molecule of H_2. All of this is true of the thing we're calling

<object, moment of proper time> pairs play roles in the new principles that are similar to the roles played by objects in the traditional principles.) Although my cases do violate stronger versions of this principle, I do not find those versions plausible, given the availability of (S**). On weak supplementation in terms of two- and three-place parthood, see Simons (1987). For a consideration of the view that *coexistence* is four-place and relativized to moments of proper time, see Balashov (2000: 162 n. 15). In my 2003 and 2004 I show that treating apparently n-adic *spatial* relations as really being 2n-adic (and relativized in the relevant manner either to regions or moments of proper time) solves certain problems for immanent universals and enduring time-travelers.

'Abel' as well. But given these observations, it becomes plausible to say that Adam has mass history MH1 only relative to the atomish way of being partitioned into instantaneous temporal parts,[33] and that Abel has the *contrary* mass history MH2 only relative to a *different* way of being partitioned into instantaneous temporal parts.[34] And since it's possible for a single thing to have one mass history relative to one way of being partitioned and a contrary mass history relative to a different way of being partitioned, none of the facts about Adam's and Abel's mass histories entails that Adam $\neq$ Abel. Parallel maneuvers could be expected to block the other arguments for the distinctness of Adam and Abel (and of Cell and Tubman).

The perdurantist who adopts this 'relativizing' treatment of mass histories seems to be committed to some view along the following lines.[35] (1) Although mass histories may appear to be monadic, intrinsic properties of things, they are in fact disguised, dyadic relations that things bear to *ways of being partitioned into instantaneous temporal parts* (for short: to *partitions*). Thus, for example, rather than saying that Adam has property MH1, we should say that Adam bears the *MH1-relative-to* relation to a certain partition. (2) The dyadic having (having *simpliciter*, just-plain-having) of mass histories must be replaced by the triadic relation *having-relative-to*. Thus, rather than saying that Adam just plain *has* MH1, we should say that Adam bears the *having* relation to MH1 and a certain partition.

[33] What is a *way of being partitioned into instantaneous temporal parts*? I shall leave this question to perdurantists.

[34] This view might be combined with a view of mass history predicates that Noonan (1993) would call *Abelardian*. According to such a view, the property expressed by that predicate varies depending upon the sense of the name to which the predicate is attached. Thus, e.g. when attached to the name ''Adam'', the predicate ''has mass history MH1'' expresses the property of having mass history MH1 relative to the atomish partition, and when attached to the name ''Abel'', that same predicate expresses a different property—namely, that of having mass history MH2 relative to the moleculean partition. This would allow the perdurantist to concede that ''Adam has MH1'' is true while ''Abel has MH1'' is false without being forced to conclude that Adam $\neq$ Abel.

[35] To keep the discussion manageable, I will not attempt a comprehensive survey of relativizing responses to my argument for the distinctness of Adam and Abel. However, I do hope to say enough to make it clear that all of the likely relativizing responses to my argument will ultimately have the same effect—namely, that of undermining Lewis's argument from temporary intrinsics against endurantism. (For surveys of relativizing responses to Lewis's argument, see Lewis (2002) and Haslanger (2003). A number of these responses suggest corresponding responses to my argument for the distinctness of Adam and Abel.)

I concede that if the perdurantist applies some relativizing treatment of this sort to mass histories or the having of them, then he can resist my argument for the distinctness of Adam and Abel. It seems to me, however, that *if* the perdurantist makes this move, he will no longer be in a position to fault the endurantist who makes a parallel relativizing move in response to David Lewis's 'problem of temporary intrinsics'.[36] Here is Lewis:

> Sometimes you sit, and then you are bent; sometimes you stand or lie, and then you are straight. How can one and the same thing have two contrary intrinsic properties? . . . I favor the hypothesis of perdurance. It says that persisting things are sums of temporal parts; their temporary intrinsic properties belong in the first instance to their temporal parts; and it is no problem that two different temporal parts can differ in their intrinsic properties. (2002: 1)

> [The endurance solution, on the other hand, runs as follows.] Contrary to what we might think, shapes are not genuine intrinsic properties. They are disguised relations, which an enduring thing may bear to times. One and the same enduring thing may bear the bent-shape relation to some times, and the straight-shape relation to others. In itself, considered apart from its relations to other things, it has no shape at all. . . . This is simply incredible . . . If we know what shape is, we know that it is a property, not a relation. (1986: 204)

> [An alternative endurantist solution holds that] it is not the intrinsic property *bent* or *straight*, but rather the copula that relates this property to a thing that has it, that turns into a relation to times. *Having* was originally thought to be a dyadic relation of things to properties; now it will instead be a triadic relation of things to properties and times . . . I protest that there is still nothing in the picture that has *bent* or *straight simpliciter*. (2002: 4–5)

> A solution to the problem of intrinsic change for enduring things should . . . not replace monadic intrinsic properties by relations . . . [and] should not replace the having *simpliciter* of properties by standing in some relation to them. (2002: 1)

It seems to me that Lewis's criticisms of these relativizing maneuvers would apply with equal force to the relativizing maneuvers that the perdurantist needs to make in order to resist the argument for the distinctness of Adam and Abel. Let me explain.

Lewis's argument from temporary intrinsics against endurantism depends upon the following principle:

[36] I am grateful to Kris McDaniel for helping to clarify my thoughts on this point.

(L) For any material object O, if O changes from being bent to being straight, then:

(i) there is a thing that just plain *has* the monadic, intrinsic, non-indexed property *being bent*, and
(ii) there is a thing that just plain *has* the monadic, intrinsic, non-indexed property *being straight*, and
(iii) necessarily: for any x and y, if x just plain has the monadic, intrinsic, non-indexed property *being bent*, and y just plain has the monadic intrinsic, non-indexed property *being straight*, then $x \neq y$.

From (L) it follows that whenever we have a thing O that changes from being bent to being straight, we have distinct things—proper temporal parts of O, presumably—one of which is bent, the other of which is straight. Endurantists reject (L). They can do so *apologetically*, conceding that (L) has some prima facie plausibility and that to reject it is to incur some cost, or *unapologetically*, arguing that (L) can be rejected at no cost at all.

Now, my main claim here is that if the endurantist incurs some cost in rejecting (L), then the perdurantist would incur some cost if he were to reject the parallel principles that can be used to argue for the distinctness of objects involved in apparent type C situations. One such principle is:

(L*) If a small hydrogen atom with a 2-billion-year-long career and a constant rest mass of 1 unit completely composes a larger hydrogen molecule with a 1-billion-year-long career and constant rest mass of more than 1 unit (in the manner illustrated by my case), then:

(i) there is a thing that just plain *has* the monadic, intrinsic, non-indexed property *being an object that has a rest mass of 1 unit throughout its 2-billion-year-long career*, and
(ii) there is a thing that just plain *has* the monadic, intrinsic, non-indexed property *being an object that has a rest mass of more than 1 unit throughout its 1-billion-year-long career*, and
(iii) necessarily: for any x and y, if x just plain has the monadic, intrinsic non-indexed property *being an object that has a rest mass of 1 unit throughout its 2-billion-year-long career* and y just plain has the monadic, intrinsic, non-indexed property *being an object that has a rest mass of more than 1 unit throughout its 1-billion-year-long career*, then $x \neq y$.

From (L*) it follows that in my Adam–Abel case, we have distinct things, one of which has a mass of 1 unit, the other of which has a mass of more than one unit. Presumably these things are Adam and Abel, respectively. The perdurantist who pursues option five and insists on identifying Adam with Abel must deny (L*).

I do not claim that this move is absolutely untenable. Perhaps it is, perhaps not. I claim only that, given the obvious parallels between principles like (L) and those like (L*), the perdurantist who rejects the latter incurs a cost comparable to that incurred by the endurantist who rejects the former. Thus the perdurantist who rejects (L*) and identifies Adam and Abel cannot in good conscience endorse Lewis's claim that the argument from temporary intrinsics is a ''decisive'' consideration against endurantism (1986: 203). So much, then, for the perdurantist's fifth option.

5. CONCLUSION

This survey of the perdurantist's options seems exhaustive: only by taking one or more of these options can the perdurantist resist my argument.[37] But, as I have noted, each of the options significantly weakens at least one important anti-endurantist argument. So, whether or not my new anti-perdurantist argument is sound, endurantism benefits.[38]

[37] Perhaps there is some way to solve type C puzzles by appeal to the sorts of nonstandard views about numerical identity (e.g. Geach 1980, Gallois 1998, T. Parsons 2000) that have been thought to solve puzzles of types A and B. Of course, the perdurantist who solves type C puzzles by appeal to such a view must abandon any argument against endurantism (e.g. Heller 1984) that assumes that such views are untenable as solutions to type A puzzles.

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