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Persistence and Properties

ABSTRACT: *If for every portion of space-time there is an object composed of its contents, four-dimensionalism will be true of these objects. But ordinary objects—trees, stones, persons, etc.—are not among these objects (although the series of events that make up their careers will be). The properties of ordinary objects, including sortal properties, are temporally local and have causal profiles that incorporate transtemporal persistence conditions of the things that have them, and this supports a rejection of four-dimensionalism in favor of three-dimensionalism as an account of the nature of these ordinary objects. Also rejected is the stage theory that takes ordinary objects to be momentary stages (whose transtemporal sameness is not identity), and the argument (of Katherine Hawley) that holds that stage theory is supported by the fact that there can be cases in which it is indeterminate whether the same thing exists at different times.*

KEYWORDS: metaphysics, ontology, D-fusion, endurance, perdurance, persistence condition

1.

It is fundamental to our ontology that there are objects, including ourselves, that persist through time. Two competing views about what this persistence consists in are endurance theory, or three-dimensionalism, according to which the persisting things exist fully at each moment of their existence, and perdurance theory, a form of four-dimensionalism, according to which the persisting things are four-dimensional objects having temporal parts. Recently, these two views have been joined by a third competitor: Stage theory, which identifies things with momentary stages and (in one version of it) uses counterpart theory to explain their apparent persistence. This is presented as a form of four-dimensionalism.

Early in his book *Four Dimensionalism* (2001) Ted Sider gives the following description of the 'pictures' associated with four-dimensionalism and three-dimensionalism: 'The four dimensional picture is that of a world spread out in time populated by space-time worms, sums of instantaneous stages from different times. The opposing three-dimensionalist picture is equally vivid: a world with objects wholly present at multiple times, sweeping in their entirety through, rather than being spread through, spacetime regions' (53). As described these do not seem to be incompatible pictures. Why shouldn't the world populated by space-time

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worms also contain objects wholly present at multiple times? It may seem that this is ruled out if we take it to be part of the four-dimensional picture that the world is populated *only* by sums of instantaneous stages from different times. But I think that there is an understanding of that on which it is compatible with the three-dimensionalist picture. Let the view be that the existence of whatever exists is realized in, or supervenes on, the existence of instantaneous stages and sums of such. It could be held that this is true of objects that are wholly present at multiple times. This version of three-dimensionalism is certainly compatible with one version of four-dimensionalism.

Later in that same book Sider defines four-dimensionalism as the view that 'necessarily, each spatiotemporal object has a temporal part at each moment at which it exists' (2001: 50). Assuming that spatiotemporal objects are objects that persist through time, this is certainly incompatible with three-dimensionalism, since three-dimensionalists hold that ordinary persisting objects lack temporal parts.[1] But the question arises whether it can be the case that the existence of objects lacking temporal parts, objects 'wholly present' at the times at which they exist, is realized in the existence of sums of instantaneous stages? I think that this can be the case. So I will be defending a version of three-dimensionalism that is compatible with a version of four-dimensionalism, although not Sider's version.

Here it is useful to consider an argument Sider gives in support of four-dimensionalism (one he regards as the 'most powerful' of the arguments he considers). David Lewis has argued that composition is unrestricted—that for every class of objects there is an object that is the fusion of that class (Lewis 1986: 212–13). As Sider develops the argument, if we adopt with Lewis a semantic theory of vagueness, there is no possibility of vagueness stemming from the application of purely logical notions, including those that would figure in specifying when a class has a fusion. Purely logical concepts cannot be vague. There cannot be a sharp boundary between classes that have fusions and those that don't, and there cannot be a vague boundary between them either. So all classes have fusions. Sider develops the argument further to apply to fusions of different classes at different times. He defines an 'assignment' as a function that takes times as arguments and non-empty classes of objects existing at those times as values and says that an object x is a *diachronic fusion* (D-fusion) of an assignment f iff for every time t in f's domain x is a fusion-at-t of f(t) (Sider 2001: 133). A minimal D-fusion of an assignment will be one that exists only at times in the assignment's domain. The argument from vagueness is then used to show that every assignment has a minimal D-fusion—that for every pairing of classes and times there is a corresponding D-fusion,

1 There are some who think that three-dimensionalists can allow ordinary objects to have temporal parts. John Hawthorne (2006) offers an account on which x is a temporal part of y iff x coincides with y at all times that x exists, and he says that in this sense the statue is a temporal part of the lump but not vice versa, and that this is something three-dimensionalists can accept. By my lights, saying that the statue is a temporal part of the lump is a misleading way of saying that the career of the statue is a temporal part of the career of the lump. But notice that this is a case in which the proposed temporal part, the statue, is an entity having persistence conditions of its own and ones distinct from those of the entity, the lump, of which it is supposed to be a temporal part. What three-dimensionalists deny is that for any persisting thing, and every interval during which that thing exists, there is such an entity coinciding with that thing during, and only during, that interval.

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an object that is the fusion of the members of those classes. Each assignment's domain will contain subsets that are the domains of other such assignments. This implies that every minimal D-fusion has temporal parts and is said to establish four-dimensionalism.

I am willing to grant, if only for sake of discussion, that this argument establishes that for any portion of spacetime there is an object composed of its contents and that these objects have temporal parts. One should agree that four-dimensionalism is true of such objects. If one further agrees that these objects include what I have been calling ordinary objects—trees, stones, people, etc.— then one should agree that four-dimensionalism is true, period. But I shall be arguing that the latter is not something we should agree to.

2.

According to four-dimensionalism, or at least according to the perdurance theory version of it, objects have temporal parts. On most versions of the theory, these parts include momentary stages, and in some versions these are the only parts that get mentioned. These are of special importance to four-dimensionalists, because they hold that in the first instance it is to these momentary stages that the properties we ascribe to objects belong—that is, for a persisting thing to have a property at a time is really for its momentary stage at that time to have the property. But it is also held, in most versions, that objects also have temporal parts that are temporally extended rather than momentary—that for any interval during which an object exists there is a temporal part of it that is the sum of the momentary stages the object has during that interval, the object itself being the sum of the momentary stages it has during its entire career. Let me focus on these temporally extended temporal parts.

These should themselves be persisting things, like the things of which they are temporal parts. But just how like these things are they? The ordinary things of which they are temporal parts have persistence conditions. Do their temporally extended temporal parts have persistence conditions of their own? Given an ordinary persisting thing there will be, on this view, a temporal part occupying each interval during which that thing exists—so there will be infinitely many overlapping temporal parts. These won't have the persistence conditions of the ordinary thing of which they are temporal parts, and apparently they won't have persistence conditions that are similar to these. They won't have persistence conditions that determine when they go out of existence. What happens during the interval during which one of them exists won't explain its going out of existence at the end of that interval, this being determined simply by that instant's being one of the pair of instants that define that part. And what happens to it at a particular time won't be explained by what happened to *it* earlier, for the same thing will happen during the existence of countless other temporal parts with which it overlaps. If any persistence condition enters into the explanation of how events happening to a temporal part are related, it will be the persistence conditions of the ordinary persisting thing of which it is a temporal part. But on most four-dimensionalist views that ordinary

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persisting thing, for example, my right shoe, will itself be a temporal part of yet larger persisting things. Will these larger things have persistence conditions of their own? If they do, their persistence conditions will have to be such as to include those of the ordinary persisting thing during its existence. But it is not clear what they could be like otherwise.

All this seems to assign a special status to the persistence conditions of ordinary objects. They impose necessary conditions on the relations between the momentary stages that make up their temporal parts (these must be such that they are all stages of the ordinary object), and they impose a necessary condition on the relations between the stages that make up the larger object of which the ordinary object is a temporal part (they must be such that a subset of them are so related as to constitute the career of the ordinary object). This is hard to square with the four-dimensionalist conception, especially the version of it that holds that all four-dimensional objects—ordinary things along with temporally extended parts of them and objects of which they themselves are temporal parts—are just sums of momentary stages. That view seems to need an explanation of how it is that the persistence conditions of ordinary objects have a privileged status vis-à-vis the identity conditions of the smaller sums of momentary stages that are their temporal parts and the larger sums of which they are parts.

Those who hold this view have an answer of sorts to the objection just raised. The objection was that four-dimensionalism makes the persistence conditions of the temporal parts of ordinary objects, and also those of the entities of which ordinary objects are temporal parts, parasitic on the persistence conditions of ordinary objects, and that this seems incompatible with the four-dimensionalist view that ordinary objects and their temporal parts are metaphysically on a par. The reply is that ordinary objects and these other four-dimensional objects are in fact on a par, metaphysically, since all of them are such that what their persistence consists in is just their being sums of particular sets of momentary stages, and that they have no need of additional persistence conditions. This is true of ordinary objects as much as it is of their temporal parts and the objects of which they are temporal parts. What we might suppose are persistence conditions determining what it is for an ordinary object to persist over time are really conditions that determine when a sum of momentary stages counts as an object of a certain kind—a tree, a person, or whatever. (There is no need for an account of when such a sum counts as a persisting thing—on this view it cannot fail to do that.) The persistence conditions belong, not to a metaphysical account of the nature of things in the world, but to a conceptual account of how our concepts apply to the world. We don't have many concepts that apply to temporal parts of ordinary things, and those we do have are coarse-grained and do not single out particular ones of the many temporal parts of particular ordinary objects. But this doesn't make for a metaphysical difference between the temporal parts and the ordinary objects that have them.

But pretending for now that there are these temporal parts, there is a difference between these and ordinary objects, a difference having to do with how they are related to the properties instantiated in the momentary stages that make up their careers. The causal profiles of these properties include features that have to do with how the instantiation of the properties affects or contributes to affecting the

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future careers of the things that have them. As I shall put it, the causal profiles of these properties point toward the future careers of their possessors. And the future careers they point toward are those of the ordinary objects, not those of their (supposed) temporal parts or of the (supposed) things of which they are temporal parts. So what these properties belong to are the ordinary objects, not temporal parts of them and not entities of which they are temporal parts.

The fact that the causal profiles of properties point toward the future careers of the things that have them shows itself most obviously in the case of dispositional properties. For something to be fragile is for that thing to be such that if subjected to certain forces it, that same thing, will break. For something to be elastic is for that thing to be such that if it, that same thing, is subjected to certain forces, it will change shape in certain ways, and when the force is removed that same thing will revert to its original shape. But the same applies to the properties that ground dispositions. For any of a large range of properties there will be a set of truths to the effect that if the property is instantiated in a thing at a time, it will continue to be instantiated in that thing at later times unless that thing is subjected to certain causal influences, and that its possession by the thing will contribute to the property's producing certain effects in it and neighboring things under certain circumstances.

It may be thought that if an instance of a property occurs in a momentary stage of an ordinary thing then that property will be instantiated not only in that thing but in any temporal part of the thing that includes that stage in its career. This will seem plausible if one thinks, as four-dimensionalists do, that in the first instance it is the momentary stage that possesses the property and that other things have the property in virtue of having the momentary stage in their careers. I think myself that in the first instance it is persisting things, not their stages, that possess the properties we ascribe to them and that saying that a momentary stage has such a property is just a misleading way of saying that the thing of which it is a stage has the property at the time in question. But if one wants properties that belong to stages, one could formulate my claim about the causal profiles of properties in a way that makes momentary stages the subjects of property instantiations; the causal profile of a property will say that if the property belongs to a momentary stage then certain things will be true of subsequent stages that are 'genidentical' to it, that is, these stages are related to that momentary stage in such a way as to be future stages of the very same thing. (I owe this way of putting it to Ted Sider. But he would not accept my gloss on 'genidentical'—as a proponent of stage theory, he does not think that the genidentity relation between stages makes them stages of one and the same thing.) The causal profile of a property of the momentary stage won't be quite the same as the causal profile of the property of the thing of which it is a stage; it is part of the latter that when the property is instantiated certain things will be true about the future of its possessor, and obviously this won't be so when the possessor is a momentary stage and so has no future. That is, properties of momentary things, call them stage properties, will be different from the corresponding properties of persisting things. The instantiation of a stage property will entail the instantiation of the corresponding property in the ordinary thing of which it is a stage, but it will not entail the instantiation of that property in things, supposing there are such, that are temporal parts of that ordinary thing. My rubber band is elastic, and we

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are supposing that there is a corresponding property, elasticity*, that belongs to its current momentary stage. If it has a temporal part whose career includes that stage, the elasticity* of that stage does not make that temporal part elastic.

3.

One thing true of the properties of ordinary things, then, is that their causal profiles point toward the future careers of the things that have these properties. Another thing true of them is that they are, as I will say, 'temporally local'—that is, these properties are such that the having of them at a time does not depend constitutively on facts about what is the case at other times. Being temporally local in this sense is compatible with having a causal profile that points toward the future; a property's having such a causal profile does not mean that its instantiation at a time implies something about what will happen after that time, but only that its instantiation at a time implies conditional truths about what will happen to its subject if certain things happen after that time.

Many sortal properties are temporally local. Some are not. For example, being an antique depends on not having been created recently, and being a tiger depends on having a certain biological history—roughly, on being descended from other tigers. But even sortal properties that are not completely temporally local are temporally local in the future direction. Something just like an antique can fail to be one because it was manufactured yesterday, but it cannot fail to be an antique because of something that will happen tomorrow. Likewise, something just like a tiger can fail to be one because it is the freak consequence of lightning hitting a swamp, but it cannot fail to be a tiger because of something that will happen next year. This raises a problem for the view, mentioned earlier, that the role of persistence conditions is to provide a rule for sorting objects into kinds when the objects are sums of momentary stages. That view would imply that what makes something belong to a kind is its temporal shape and size, that is, what is true of it over a period of time. In other words, the property of belonging to a certain kind would not be temporally local, not even in the future direction. If, instead, sortal properties are temporally local, then something's being of a kind at a time is determined by what is true of it at that time. That is, its being of that kind at a time is unaffected by whether it ceases to exist immediately after that time or whether it undergoes some radical change, as long as that change is one allowed by the persistence conditions that go with being of that kind. This will be true at every time at which the thing exists; its sortal properties and its causally individuated properties will belong to it in virtue of how it is, intrinsically, at that time. This could be expressed by saying that it is wholly present at every time at which it exists. And this, of course, implies three-dimensionalism.

In the case of entities such as events and processes, the properties ascribed to them tend not to be temporally local. An event's temporal shape and size enter into determining whether it is a war, a hurricane, an epidemic, a football game, or whatever. The intrinsic properties instantiated at a moment of time do not by themselves determine whether an epidemic is occurring at that moment; whether

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that is the case depends on what happened before and after that moment. (Perhaps the property of being a football game is closer to being temporally local than the property of being a war or an epidemic because of the role of human intentions in determining what count as instantiations of it—the football game was going on at *t*, even if subsequent events prevent its completion. But nothing that happens at a time can make it true that a game was going on then if the events that preceded that time were not of the right sort.) This is an important categorical difference between events (processes, etc.) and objects, and one that plays an important role in determining what things do, and what things do not, have temporal parts.

4.

Lots of things have temporal parts. Events like games, wars, and storms do. The careers of persons do. Volumes of spacetime do. And Sider's minimal D-fusions do. But being a four-dimensionalist about one sort of things does not require being a four-dimensionalist about all sorts of things. My claim is that we should not be four-dimensionalists about ordinary persisting objects, those that figure in everyday discourse and in the 'manifest image' of the world. I think this is a consequence of the fact that the properties of such objects are characteristically temporally local and point toward the future careers of the things that have these properties.

But associated with every ordinary object there will be a minimal D-fusion that physically duplicates that object's history. Or to put it differently, associated with every ordinary object there will be a spacetime worm that has a claim to be that object's career. Holding the view that ordinary objects are entities that are over and above these minimal D-fusions or spacetime worms might be considered a threat to physicalism, or at least to ontological economy. Sider says that if there are such things as points and regions of spacetime, then unless we identify objects with regions of spacetime we

> seem to gratuitously add a category of objects to our ontology. All the properties apparently had by an occupant of spacetime can be understood as being instantiated by the region of spacetime itself. The identification of spatiotemporal objects with the regions is just crying out to be made. Given the identification, perdurance follows, since spacetime perdures. (2001: 110)

In this passage Sider is assuming 'substantialism' about spacetime, but in fact he is neutral about whether substantialism or relationalism is true—he thinks that four-dimensionalism is true in either case. But I think that what he says here about objects and regions of spacetime (assuming substantialism) he would also say about objects and minimal D-fusions (or spacetime worms).

Of course, I deny that the properties we take to be had by occupants of spacetime can be understood as instantiated by regions of spacetime. That would be incompatible with their being temporally local in the sense I have explained. Likewise, I deny that these properties can be understood as being instantiated by spacetime worms (this would be incompatible with their being temporally local)

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or by momentary stages of such (this would be incompatible with their being individuated by causal profiles that point toward the futures of the things that have the properties). But these denials do not commit me to denying that there is a good sense in which all of the facts about the world are determined, constitutively, by facts about spacetime worms (minimal D-fusions) and their properties. The properties of ordinary objects are not instantiated in spacetime worms or their stages; rather, assuming physicalism, their instantiations are realized by microphysical states of affairs consisting in facts about the constituents of spacetime worms. Ordinary objects are not identical with spacetime worms or the like, but their existence is realized by the existence of spacetime worms of certain sorts.

The important realization relation here is the one involved in the microrealization of properties—the realization of property instances by microphysical states of affairs. Roughly, a microphysical state of affairs realizes an instance of a particular property if its causal relations to other microphysical states of affairs mirror in a certain way the network of causal relations to other properties that is implicit in the causal profile of the property. (I give a slightly less rough characterization of this in Shoemaker 2007 and 2013.) It is important that the microphysical realization of properties is a holistic affair; a property's being so realized must necessarily belong to a family of properties that are causally related in complex ways, where the other properties in the family are likewise microphysically realized. The instantiation of a property requires that there *be* an object in which it is instantiated, and its instantiation in that object requires that that object has various other properties belonging to that family of properties and that the instances of these properties in the object stand to one another in certain causal relations. The existence of the object requires that there be a system of microphysical states of affairs so related as to constitute realizers of instances of members of this family, where this includes being such as to generate new microphysical states of affairs and property instances realized by them and (in cases of change) to terminate the existence of some of the previously existing states of affairs. It is facts like these that realize the existence of objects capable of having the properties—the realization of the objects is part and parcel of the realization of the properties and their instances.

My rejection of four-dimensionalism, and my endorsement of three-dimensionalism, is grounded in my claim about the properties of ordinary objects—namely, that these properties are characteristically temporally local and characteristically have causal profiles that point toward the future careers of the things that have these properties. If properties having these features can be realized in the microphysical states of affairs that occur in spacetime worms, then it is compatible with physicalism that objects having these properties—and thus objects of which three-dimensionalism is true—can be realized in the microphysical states of affairs that underlie the existence of spacetime worms. In my view, then, there is no doubt that such properties can be so realized. For the realization of properties that are temporally local we need microphysical realizers that are temporally local—that is, microphysical states of affairs that hold in virtue of what is true at particular times and whose existence does not constitutively depend on what is true at other times. For the realization of properties whose causal profiles point toward the futures of their possessors we need something more complicated. Here

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the causal profiles of the microphysical realizers must be such as to make true conditional propositions about what effects their existence can have on later states of affairs related to them in such a way as to constitute the persistence of an object over time. If there are properties that can be realized in these ways, then three-dimensionalism is true in a world that satisfies Sider's description of how things are if four-dimensionalism is true.

Sometimes it is suggested that what we think of as substances are better thought of as events or processes. This is thought to fit better with a scientific view of nature. But what I have argued is that it is possible to hold both that the world consists of events and processes, extended through time, and that it consists of objects or substances, each wholly existing at each time at which it exists. Some of the events and processes are careers of persisting objects. The properties had by these objects are realized in states of affairs that collectively make up their careers, and, as I said earlier, the existence of the objects is itself realized in the states of affairs that make up their careers. It would sound strange to say that careers are more fundamental than the things that have them, for of course nothing counts as a career unless there is some object whose career it is. But there is a good sense in which the processes, the series of microphysical states of affairs of which careers are a special case, are more fundamental than objects. There could be a world in which there are such processes but no objects (except, perhaps, for microparticles). In the world as it is, some of the processes exhibit a kind of order and stability that makes them careers and makes their constituent states of affairs realizers of property instances and of objects in which these are instantiated. We ourselves are such objects, and our perceptual systems are keyed to the detection of objects of our own kind and also to the detection of objects of other kinds, including those that serve as food and shelter for us and those that can be obstacles to our movements or threats to our well-being and survival. Perhaps it could be said that three-dimensionalism is true of the world as we perceive and know it, and four-dimensionalism is true of the entities that serve as the realization base for that world.

5·

So far I have written as if the only competitor to three-dimensionalism is the version of four-dimensionalism that identifies ordinary objects with spacetime worms or what Sider calls D-fusions. A different competitor to three-dimensionalism is the view, held by Sider and by Katherine Hawley (2001), that is sometimes called Stage theory. This view holds that ordinary objects are momentary stages of spacetime worms. It denies that ordinary objects persist in a way that involves an object at one time being identical with an object existing at another time. But it holds that ordinary claims that seem to imply such persistence can be true in virtue of there being a relation between stages occurring at different times. In Sider's version this is a counterpart relation. It is true that I ate a banana this morning in virtue of the fact that the current stage that is me has as a counterpart a stage that included the eating of a banana. Of course, since eating a banana takes time, what we should say is that the current stage has as counterparts a number of different stages that collectively

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constitute the eating of a banana. In Hawley's version the relation is just a same-F relation (same person, same tree, etc.) the holding of which does not imply that the stages so related belong to numerically the same thing. It is true that I am the same as the person who ate the banana—it is just that 'same' does not here express identity. I think that the difference between these versions is only terminological. At any rate, the stage theorist will claim that ordinary talk about persistence, including claims of personal identity, can be accommodated by the theory.

Since momentary stages cannot have temporal parts, it does not appear that a stage theorist can hold that ordinary objects have temporal parts. Of course, stage theorists can hold that corresponding to any ordinary object there is a series of stages made up of the stages that are counterparts of the stage that object is, or stand that to it in the appropriate same-F relation, and that this series has temporal parts. This is comparable with the three-dimensionalist's claim that corresponding to any ordinary object there is a series of stages that make up that object's career, and that this series has temporal parts. What makes stage theory a version of four-dimensionalism is that it holds—in contrast to three-dimensionalism—that any spatiotemporal object, any object that lasts through time, has temporal parts.[2] But it does not identify ordinary objects with such spatiotemporal objects.

This might seem to be an error theory, which attributes to us a mistaken view—the view that objects persist over time—and offers an explanation of why we have it. But I do not think that this is right. The word 'same' is already ambiguous, expressing both qualitative and numerical identity, and we can't rule out a priori that it is ambiguous in yet another way—that it has a use that allows for sameness over time that is neither numerical identity nor resemblance. Stage theorists allow that objects persist; they merely hold that such persistence does not involve numerical identity over time. I don't think that amounts to an error theory.

One question about this view concerns the properties of stages that enable them to stand in counterpart relations or same-F relations to other stages. Apparently, these cannot be properties of the sort we take ordinary objects to have. For these latter, as I have been insisting, are properties having causal profiles that point toward the futures of the things that have the properties. These cannot belong to durationless stages. But there is a possible reply to this. I said earlier that if one wants properties that belong to momentary stages, one can express the point that the causal profiles of properties point toward the future by saying that when a property belongs to a momentary stage certain things will be true concerning subsequent stages that are 'genidentical' to that stage. I took genidentity to be what John Perry calls the unity relation—that is, the relation holding between the different stages that make up the career of a single persisting object. But stage theorists might instead take genidentity to be the counterpart relation or the same-F relation that underlies persistence. So they might hold that the future properties point toward is not really the future of the very things that have these properties.

But what are these stages that stage theory identifies ordinary objects with? Ordinarily, we think of stages as momentary parts of the careers of persisting

2 Sider defines four-dimensionalism as the view that 'necessarily, each spatiotemporal object has a temporal part at each moment at which it exists' (2001: 59).

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objects. But that makes the notion of a stage parasitic on the notion of a persisting object, and this can hardly be the way stage theory wants to construe a stage. Stages are supposed to be metaphysically basic entities. How can they figure in a physicalist account of the world? If I am a momentary stage, is the stage I am perhaps the sum of stages of the fundamental particles that make me up? One difficulty here comes from special relativity—only relative to a frame of reference can particle stages be simultaneous, and it is hard to square this with the idea that simultaneous sets of these can be the basic entities. Relative to different frames I (if I were a momentary stage) will be different stages, and it does not seem that one of these frames could be metaphysically privileged. For my own part, I do not believe in stages qua momentary subjects of properties. The stages I believe in are sets of simultaneous property instances—and it cannot be these that stage theory takes ordinary objects to be.

6.

I now want to consider an objection to endurance theory that is also an argument in favor of stage theory. The objection is due to Katherine Hawley. It stems from the fact that there can apparently be borderline cases of persistence, cases in which it is indeterminate whether something existing at one time is identical with something existing at a different time. You and I take our bicycles to be repaired, and when we get back what we are told are our bikes, we find that the one I have has a number of the parts that previously belonged to yours, and similarly, the one you have has a number of the parts that previously belonged to mine. A workman in the repair shop got confused when putting them together. It might here be indeterminate whether the bike I have is the same as the bike I brought in. Or take a case involving persons: one hemisphere of someone's brain is transplanted to someone else's body, and after the transplant the psychology of the recipient is a mixture of the psychologies of the donor and the pretransplant recipient, with the psychology of the donor predominating. Here it might be indeterminate whether the posttransplant recipient person is identical with the pretransplant donor.

There is a well-known argument of Gareth Evans and Nathan Salmon that identity cannot be vague, cannot be indeterminate. Suppose that it is indeterminate whether *A* is identical with *B*. That is, *A* has the property of being such that it is indeterminate whether it is identical to *B*. Since *B* is determinately identical to *B*, it cannot have that property. Since *A* has a property *B* lacks, it is determinately not identical to *B*, contrary to our initial supposition that it is indeterminate whether it is.

Hawley takes an argument similar to this to show that if it is indeterminate whether the statement '*A* is identical to *B*' is true, the indeterminacy cannot be 'ontic'. The other possibilities are that it is epistemic and that it is semantic. It is epistemic if there is a fact of the matter as to whether it is true, but it is impossible for us to know whether it is so. She finds this implausible, and I agree. If it is semantic, the indeterminacy is due to referential ambiguity. Let the identity statement be '*A* existing at time t_1 is identical with *B* existing at time t_2'. To suppose that *A* and *B* both refer determinately—that is, to suppose that each refers to just one thing

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and that the truth-value of the statement is indeterminate—is to run afoul of the Evans/Salmon argument. '*A*''s sole referent will have the property of being such that it is indeterminate whether it is identical to the sole referent of '*B*', while '*B*''s sole referent will not have that property; the result then is that '*A*''s sole referent is not identical to '*B*''s sole referent, and we don't have the indeterminacy we set out to explain. Hawley thinks that to avoid this a proponent of the endurance view must hold that '*A*' and '*B*' do not refer uniquely. Instead, each must have more than one referent, and one referent of '*A*' will be identical with one referent of '*B*' while another referent of '*A*' will be non-identical with a referent of '*B*'. But this has the undesirable consequence that in my bicycle example the words 'this bike' refers to two different but coincident bikes, one of which is identical to a bike I took in for repairs and the other one isn't. What is worse, it has the consequence that if it is so much as possible that there should be an event in the future that would make it indeterminate whether someone existing after that event is me, then right now my word 'I' refers to two different but coincident persons, such that if such an event occurred, one of them would be identical with someone existing after that event and the other would not. We can call this the problem of unwanted coincident entities. Stage theory is thought not to face this problem, but I will question this later.

One way in which the truth-value of statements of transtemporal identity could be indeterminate is if the diachronic unity relation between stages at different times were indeterminate—that is, if it were indeterminate whether the relation between stages at different times is such as to make them stages of a single thing. The idea would be that in a case of indeterminacy there is one sharpening of the unity relation on which it holds between stages at two different times and another sharpening of it on which it doesn't hold. This requires both that an object existing at the one time is identical to an object existing at the other time, in virtue of its stage at that time standing in one sharpening of the unity relation to a stage of the other, and that an object existing at that time is not identical to an object existing at the other time, in virtue of its stage at that time not standing in the other sharpening of the unity relation to a stage of the other. For this to be true it must be the case that at least one of the momentary stages is a stage of two different objects. If we make the plausible assumption that a single stage cannot belong to two different objects, we need a slightly different account—one that says that at one or both of the times there are two object stages in what appears to be a single object, and that one of these stands in a sharpening of the diachronic unity relation to a stage at the other time while the other doesn't. Either way we will be saddled with unwanted coincident objects.

But it is not only indeterminacy of the diachronic unity relation that can account for indeterminacy of transtemporal identity. Indeterminacy of the synchronic unity relation can do so as well. The synchronic unity relation is what determines whether different property instances belong to a single momentary stage or to different stages. If it is indeterminate whether this holds between property instances occurring at a time, it will be indeterminate whether these make up one stage or more than one. So consider the identity proposition '*A* at t_1 is identical with *B* at t_2', and suppose that it is indeterminate whether the t_1 property instances stand in the synchronic unity relation to one another, and that it is likewise indeterminate

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whether the *t2* property instances do. Accordingly, it will be indeterminate whether the *t1* property instances belong to a single object or to more than one object, and likewise it will be indeterminate whether the *t2* property instances do so. It will be indeterminate whether '*A*' and '*B*'' refer uniquely. This makes the truth-value of '*A* at *t1* is identical to *B* at *t2*' indeterminate. What in the first instance it makes indeterminate is whether the truth value of that statement is indeterminate owing to '*A*' and '*B*' being ambiguous. But given that it is indeterminate whether the truth-value of the statement is indeterminate in this way, it cannot be straightforwardly determinate that it is true or straightforwardly determinate that it is false. By holding that it can be indeterminate whether the synchronic unity relation holds, endurance theorists can avoid commitment to unwanted coincident objects in cases where the truth-value of identity statements is indeterminate.

To be sure, while this does not have the consequence that in such cases there are coincident objects, it does have the consequence that in such cases it is indeterminate whether there are coincident objects. Suppose that there could occur at some future time an event in my brain whose consequences make it indeterminate whether the possessor of my body after that event would be me. According to Hawley, endurance theory has the consequence that at some time prior to that future time my body harbors (at least) two coincident persons, one of which would survive if such an event occurred while the other would not. This is certainly a very unattractive consequence. On the view I have suggested, endurance theory need only embrace the consequence that it is indeterminate whether my body will at such a time harbor such coincident persons. This is a less unattractive consequence, but it is still unattractive, and it would be nice if we could avoid it.

But the consequence that it can be indeterminate whether what looks to be the body of a normal person houses two or more coincident persons is one I think stage theory is also committed to. Like endurance theorists, stage theorists must allow that the synchronic unity relation can be indeterminate, making it indeterminate whether a set of property instances makes up a single stage or more than one. This being so would be one possible explanation of the indeterminacy of the transtemporal sameness (not identity) stage theorists believe to be possible, that is, the possible cases in which it is indeterminate whether the statement '*A* at *t1* is the same as *B* at *t2*' is true, where that statement is understood, in accordance with stage theory, as saying that *A* and *B* stand in a counterpart or same-F relation that is not identity. In such a case it will be indeterminate whether '*A*' refers to one stage or more than one, and likewise it will be indeterminate whether '*B*' refers uniquely or ambiguously. This is as much a possibility on stage theory as it is on endurance theory.

To be sure, it is open to stage theorists to say that while this is possible, in actual cases of indeterminacy of transtemporal sameness the indeterminacy is not due to the indeterminacy of the synchronic unity relation but instead is due to the indeterminacy of the counterpart or same-F relation. But we need to consider what this indeterminacy would consist in. It would, of course, have to consist in whatever would make questions about transtemporal sameness unanswerable. I think that it would have to reflect indeterminacy in the causal profiles of the properties instantiated in the stages, where these profiles dictate how instances of

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the properties affect the future careers of the things that have the properties. But if there is indeterminacy in these causal profiles, there should be properties having causal profiles that are sharpenings of them. And in cases where this indeterminacy yields indeterminacy of transtemporal sameness there should be one subset of these properties whose causal profiles indicate that the stage containing their instances is the same as a stage existing at a different time and another subset of them whose causal profiles indicate that the stage containing their instances is not the same as a stage existing at that other time. It would seem that stage theorists would want to hold that the instances of these two subsets of properties make up different stages, one standing in the diachronic unity relation to the stage at the other time and the other standing in a diachronic difference relation to that stage. That is, the view would be that where we seem to have a single stage composed of instances of a set of properties, in reality we have two stages composed of instances of properties whose causal profiles are sharpenings of those in that set of properties, one of which stands in a diachronic unity relation to a stage at another time and the other of which doesn't. Stage theory, then, seems to be committed to unwanted coincident objects—more precisely, to unwanted coincident stages. It can avoid this commitment by holding that what the indeterminacy of the causal profiles yields in such cases—namely, in cases of indeterminacy of transtemporal sameness—is not coincident stages but indeterminacy as to whether there are coincident stages. And that is similar to what I have suggested endurance theorists should hold.

I find the topic of indeterminacy a swamp in which it is difficult to find one's way. But the upshot of my discussion here is that the possible indeterminacy of transtemporal sameness poses no more of a problem for proponents of endurance theory than it does for proponents of stage theory.

7.

Finally, I would like to address a recent criticism directed at three-dimensionalist accounts. In a recent paper Michael Della Rocca (2011) argues that three-dimensionalism is committed to persistence being primitive and so cannot give the sort of account of it, in terms of causal and other sorts of continuity, that three-dimensionalists (and others) have tried to give. His argument for this claim is as follows:

> For the 3d'ist, persistence of an object is explained, in part at least, in terms of a succession of states of a *single object over time*, that is, states of the persisting object. Thus Kurtz characterizes 3d'ists as understanding "change over time as a phenomenon that is nothing more than a numerically identical object instantiating different properties across time." And so, for the 3d'ist, the persistence of the object is explained in part in terms of the persistence of the object itself. Thus the persistence of the object is not really explained at all; it is primitive. It is essential to the 3d'ist's position that an object's persistence is thus

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> primitive. There is no independent explanation to be had: the object persists, in part at least, because the object persists (2011: 595–96).

It is of course true that when an object persists, the successive states in its career all belong to the same object. This is true on any view, three-dimensionalist or not, for it follows from what is meant by 'persist'. But by no means does it follow, as Della Rocca's argument implies, that each of the different states must be specified as belonging to the *same* object as each of the others. Three- dimensionalists can think of each of these different states as an event or state of affairs consisting in there being at a time an object having certain properties. The specification of each of these properties leaves it open whether the object involved in it is the same as that involved in other stages occurring in the succession. What makes it a fact that the same object is involved in all the states is the causal and qualitative continuity in the succession of states. This gives three-dimensionalists a noncircular explanation of persistence (one also available to four-dimensionalists and stage theorists). There is no commitment here to the primitiveness of persistence.

This should be apparent on the view sketched earlier, on which the existence of an object at a time is realized by a microphysical state of affairs existing at that time. The persistence of an object over time will consist in a series of such states of affairs, what we might call 'object-realizing states of affairs', exhibiting causal and qualitative continuity of a certain sort. That the object-realizing states of affairs realize the same object is, of course, not assumed; it is concluded from the existence of the relevant continuities in the series.

I think there is some affinity between Della Rocca's claim that three-dimensionalists take persistence to be 'primitive' and Katherine Hawley's view that 'in a sense, endurance theorists suppose that the only "suitable relation" which binds stages together to make objects is the relation of identity, a relation which, as Evans has shown, must be all-or-nothing' (2001: 137). Obviously she cannot mean that endurance theorists hold that the different stages of a persisting thing are identical. But she appears to think that all that endurance theorists can say about what 'binds stages together to make objects' is that they are stages of one and the same thing. She appears to think that it is not open to endurance theorists to give a constitutive account of persistence in terms of relations, causal and qualitative continuity of certain sorts, holding between stages. Of course, I think this is wrong. Endurance theorists, perdurance theorists, and stage theorists can give the same account of the truth conditions for statements of transtemporal sameness—all can hold that such sameness consists in the holding of relations of causal and qualitative continuity between stages occurring at different times. What they disagree about is the nature of the stages, how they relate to the properties ascribed to persisting things, and whether the sameness is numerical identity.

8.

I favor endurance theory, that is, three-dimensionalism. It seems to me far and away the most intuitive of the competing views about persistence. It squares with

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our ordinary ways of talking about persisting things in ways the competing views do not. And its competitors seem to me open to serious objections, the most serious of which is that they cannot accommodate the kinds of properties that figure in our thinking about persisting things. I have held for some time that there is an internal relation between the nature of properties and the nature of the persistence of objects through time. This is the point, which has figured prominently in the argument of this paper, that the properties of persisting things are individuated by causal profiles that point toward the futures of the things that have them. More prosaically, the causal features of these properties include ones that contribute to affecting the future careers of their possessors in certain ways. I have claimed elsewhere, and still believe, that this is necessarily true of these properties. But it is enough for present purposes that it is true of them. It is also true of most of the properties we ascribe to persisting things that they are temporally local—that they belong to things at times in virtue of what is intrinsically true of the things at those times. That this holds of sortal properties goes with the endurance theorists' view that persisting things are wholly present at each moment of their existence.

As I have stressed, the three-dimensionalism I endorse concerns only 'ordinary objects', the objects that figure in everyday thought and discourse about the world. It is these objects that lack temporal parts. The careers of such objects have temporal parts, and so do events and processes of various kinds. And I have no quarrel with the claim that there are what Sider calls D-fusions, objects composed of the contents of portions of spacetime, and that these have temporal parts. Four-dimensionalism is true of such entities. I even allow that the existence of ordinary objects can be said to be grounded in the existence of such entities. What is not true is that ordinary objects *are* such entities.

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