

ABOUT STAGE UNIVERSALISM

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ABSTRACT

Most four-dimensionalists, including both worm and stage theorists, endorse mereological universalism, the thesis that any class of objects has a fusion. But the marriage of four-dimensionalism and universalism is unfortunate and unprofitable: it creates a recalcitrant problem for stage theory's account of lingering properties, such as *writing 'War and Piece'* and *traveling across the tennis court*, which take time to be instantiated. This makes it necessary to impose a natural restriction on diachronic composition.

I. Introduction

Four-dimensionalism (hereafter 4D) is the view that concrete objects have temporal parts, or stages, at all moments at which they exist.¹ This view comes in two varieties. For *worm theory*, ordinary continuants (rocks, tables, cats and persons) are temporally extended and persist over time much like roads and rivers persist through space. For *stage theory*, ordinary objects are instantaneous stages rather than temporally extended perduring 'worms'. They persist over time by having temporal counterparts at different moments. Although persisting objects are, on this

¹ 'x is an *instantaneous temporal part* of y at instant t =_{df} (1) x exists at, but only at, t; (2) x is part of y at t; and (3) x overlaps at t everything that is part of y at t' (T. Sider, *Four-Dimensionalism. An Ontology of Persistence and Time* (Oxford: Clarendon Press, 2001), p. 59).

view, three-dimensional and wholly present at single instants, they cannot be literally present at more than one time, as is allowed by three-dimensionalism, or endurantism.

Stage theory counts as a variety of (4D) because it acknowledges the existence of temporally extended sums or fusions of momentary stages. In contrast with worm theory, however, it does not equate these fusions with ordinary persistent things. A cat is not a perduring cat-worm, but rather an instantaneous cat-stage. Since both theories accept stages as well as their sums into their ontologies, the difference between them is typically regarded as merely semantic, not metaphysical.²

Most adherents of (4D), worm and stage theorists alike, endorse mereological *universalism*, the thesis that any class of objects has a fusion. In the hands of the worm theorist, this gives rise to the view that any filled region of spacetime contains an object.³ In the hands of the stage theorist, universalism yields the notion that any class of object-stages from different times is unified by a certain counterpart relation (or so I argue below in §III). To my mind, the marriage of (4D) (in both its versions) with universalism is unfortunate and unprofitable.⁴ In this paper I focus on stage theory and argue that universalist commitments create a recalcitrant problem for that theory's account of *lingering properties* – properties such as *writing 'War and Piece'* and

² But for some reservations, see K. Hawley, *How Things Persist* (Oxford: Clarendon Press, 2001), pp. 44, 47 and A. Varzi, 'Naming the Stages', *Dialectica*, 57 (2003), pp. 387–412.

³ See, e.g., W.V. Quine, *Word and Object* (M.I.T Press, 1960), p. 171; M. Heller, *The Ontology of Physical Objects: Four-dimensional Hunks of Matter* (Cambridge UP, 1990); H. Hudson, *A Materialist Metaphysics of the Human Person* (Cornell UP, 2001), ch. 3, and 'Immanent Causality and Diachronic Composition: a Reply to Balashov', *Philosophical Papers*, 32 (2003), pp. 15–23.

⁴ See my 'Temporal Parts and Superluminal Motion' and 'Restricted Diachronic Composition, Immanent Causality, and Objecthood: A Reply to Hudson', *Philosophical Papers*, 32 (2003), pp. 1–13 and 23–30; and 'On Vagueness, 4D and Diachronic Universalism', *Australasian Journal of Philosophy*, 83 (2005), pp. 523–31.

traveling across the tennis court, which take time to be instantiated.⁵

I recommend rejecting universalism, by imposing a broadly causal restriction on *diachronic* composition. I argue that this by itself does not commit one to any particular view of *synchronic* composition. I thus take issue with those who regard universalism as a package-deal, and also with the popular view that temporal parts theorists must be universalists across the board. This view is wrong because it fails to note an important difference between synchronic and diachronic composition.

It should be noted that the problem with lingering properties considered below does not affect worm theory directly. But if I am right about the tight connection between diachronic universalism and counterpart universalism (§III) then in the end the problem has the same implication for both versions of (4D), thus compelling 4D in any guise to reject unrestricted diachronic composition.

I begin by outlining stage theory's general account of temporal predication and its application to lingering properties. In §IV I argue that commitment to diachronic universalism leads to a problem with attribution of such properties to object-stages. In §§V–VII I resist ways to remedy the problem which come short of rejecting diachronic universalism. In §VIII I discuss the implications of its rejection.

II. Lingering Properties of Stages

In the stock example, a poker is hot tonight and cold tomorrow. One useful way to think of this in terms of stage theory is to allow the description 'the poker' to have multiple referents; *mutatis mutandis* for other singular terms. At different times, 'the poker' refers to different poker-stages, which are the *same* poker, where

⁵ The term 'lingering properties' is due to Katherine Hawley, *How Things Persist*, pp. 54ff., although she prefers to speak of the satisfaction of lingering *predicates*, to avoid the issue of what properties there are. I opt for properties and adopt a liberal attitude towards them.

sameness should be construed not as numerical identity, but as a temporal counterpart relation, R_p .⁶ One of tonight's poker stages, poker_1 , is a familiar ordinary object, a poker, and is hot. This object will persist until tomorrow and will be cold then. How can a *momentary* object accomplish this feat? Stage theory's answer is that poker_1 persists by 'exduring',⁷ and possesses the *historical* property *will be cold* by being R_p -related to poker_2 , a certain poker-stage tomorrow, which is cold *simpliciter*.

The stage view's reliance on the counterpart account of persistence and temporal predication incurs a theoretical cost. But it also provides for important benefits, chief among them being immunity to the problem of temporary intrinsics and the ability to offer the best unified solution to the puzzles of material coincidence – the benefits which have earned stage theory a leading position in the debate about persistence.⁸

How short are object stages? Although the view that they have non-zero duration could perhaps be coherently developed,⁹ it is more natural to require that stages be instantaneous, to accommodate as simply as possible continuous change of spatial position and of other instantaneous properties.¹⁰ I do not think that 'instantism' is, in the end, crucial to my arguments below. But it makes their presentation much simpler, and so I shall adopt it in

⁶ On 'sameness through time', as distinct from sameness of identity, see Hawley, pp. 62ff.

⁷ The term 'exdurance' is due to Sally Haslanger, 'Persistence Through Time', in M.J. Loux and D. Zimmerman (eds.), *The Oxford Handbook of Metaphysics* (Oxford UP, 2003), pp. 315–54. For a rigorous definition, see my 'Defining "Exdurance"', *Philosophical Studies*, forthcoming.

⁸ For details, see Sider, pp. 188–208; Hawley, chs 2, 6. For a brief review, see Varzi.

⁹ See J. Butterfield, 'The Rotating Discs Argument Defeated', *British Journal for the Philosophy of Science*, 57 (2006), pp. 1–45, for a recent proposal. The view that all stages are temporally extended could then be combined with the view that time itself is 'gunky' (if the latter view could be coherently developed). On gunky space and time, see F. Arntzenius, 'Gunk, Topology and Measure', *PhilSci Archive*, <http://philsci-archive.pitt.edu/archive/00001792> (preprint).

¹⁰ See Hawley, p. 50; Sider, pp. 197–8.

what follows. There is a sense, then, in which ordinary objects – tennis balls, cats and persons – are, according to stage theory, very short-lived. As noted above, this does not prevent them from persisting, according to the counterpart view. What about property possession?

Momentary stages are clearly capable of possessing many familiar momentary properties, such as colour, shape or position. But the instantaneous nature of object-stages appears to prevent them from having ‘lingering’ properties, which take time to be instantiated. Examples include *orbiting the Earth*, *speeding*, *traveling across the tennis court*, *getting wet*, *dreaming of the Bahamas*, and *writing ‘War and Peace’*. A single object-stage can *be* wet, but it does not seem capable of *getting* wet, for that requires being first dry and then wet, and no instantaneous entity can be both. Similarly, orbiting the Earth *now* involves having certain properties in the past and future.

But I have pointed out that attribution of past and future properties to present stages does not create an insurmountable problem for stage theory. My current stage can be getting wet by being covered with water and being counterpart-related to earlier stages that are dry and to later stages that are covered with more water. Single object-stages can have lingering properties by standing in appropriate relations to surrounding stages. Lingering properties are, on this view, highly relational, but they are none the less the properties of instantaneous objects. And this, upon reflection, seems to be the right result. Moreover, it is a familiar result. Many physical properties, such as velocity or acceleration, are instantaneous, but their possession by objects at single instants is partly a matter of what goes on at other instants. There are also useful spatial analogies: an array of bricks comes to possess the property of being a wall by being appropriately related to other parts of the house.¹¹ An isolated array of bricks does not have this property. Despite being, in this sense, relational, the property in question is possessed by a *single* array of bricks, for a single such

¹¹ Cf. Hawley, p. 65; Sider, pp. 197–8.

array need not be isolated. Similarly, an isolated stage cannot be writing *War and Peace*. But a single stage can, for single stages need not be isolated.

In general, object o at t (i.e., a momentary object-stage) has a lingering property P_L in virtue of (a) having intrinsic features pertinent to instantiating P_L at t , and (b) bearing R_o to object stages at times earlier and later than t , where such stages have certain intrinsic features pertinent to o 's instantiating P_L at t and R_o is a counterpart relation unifying the object stages in question.

So far so good. Now for universalism.

III. Universalism, Synchronic and Diachronic

I take universalism to be a conjunction of two separate theses, synchronic universalism and diachronic universalism. For synchronic universalism, any class of objects existing at a certain time has a fusion at that time.

(SU) Any class of objects existing at t has a fusion at t .¹²

For example, the class of my cells at t has a fusion at t ; but so does the class consisting of my left hand at t and a certain cucumber at t . The first fusion is a familiar object, me, at t ; the second is an unfamiliar object, for which we do not have a designation.

This statement of (SU) is neutral between three- and four-dimensionalism. The thesis of diachronic universalism, on the other hand, is of interest here only in so far as it applies to four-dimensionalism. In the context of four-dimensionalism, this thesis asserts that any class of objects that exist at different times has a fusion:

¹² The notion of fusion at work in (SU) is thus temporally qualified. On temporally relativized mereology, see, e.g., Sider, pp. 55–73 and 132–4.

About Stage Universalism

- (DU) Any class of momentary objects $\{o(t), t \in T\}$ has a (diachronic) fusion.

T is an arbitrary set of times, which need not be continuous. According to (DU), the class of my momentary temporal parts throughout my entire life has a fusion, and so does the class of my weekday temporal parts interspersed with the weekend temporal parts of a certain cucumber. The first fusion is a familiar object (*viz.* me), for the worm theorist, and a less familiar entity for the stage theorist; the second is a totally unfamiliar entity for which we do not have a designation. Both diachronic fusions are composed of momentary objects bearing to each other respective counterpart relations, the person-counterpart relation R_I in the first case, and a certain non-person-counterpart relation R_X in the second.

Does being a part of a diachronic fusion z necessitate standing in some counterpart relation, picked out by the phrase ‘ x is a temporal part of the same four-dimensional entity as y ’, to other parts of that fusion? In other words, does (DU) entail ‘counterpart universalism’?¹³ The latter could be expressed as

- (CU) Any two momentary objects existing at distinct times bear a (temporal) counterpart relation to each other.

Perhaps relations are sparse, and the fact that x and y both bear a certain relation to z (*viz.*, temporal parthood) does not guarantee that they stand in any relation to each other. Or perhaps relations are abundant, but the phrase ‘ x is a temporal part of the same 4D entity as y ’ fails to pick out a *counterpart* relation.

Perhaps both possibilities are open. I submit, however, that anyone who adopts the combination of (4D) and (DU) has overwhelming reasons to endorse counterpart universalism. First, the relation denoted by ‘ x is a temporal part of the same four-dimensional entity as y ’ is simply the mereological relation of

¹³ I owe this important question to a referee.

underlap restricted to temporal parts: $x \text{ underlaps } y =_{df} \exists z (x \text{ is part of } z \wedge y \text{ is part of } z)$. Conceptually, *underlap* is on a par with *overlap*, a reputable relation which figures centrally in general mereology: $x \text{ overlaps } y =_{df} \exists z (z \text{ is part of } x \wedge z \text{ is part of } y)$. This recommends treating *underlap* as equally significant. The question then is whether temporal *underlap* has the characteristics of temporal counterparthood. It certainly does, for temporal counterparthood performs exactly the same work for stage theory as temporal parthood does for worm theory. Suppose the worm theorist provides certain reasons (whatever they are) to think that x and y are temporal parts, or stages, of a single object z (and, hence, are related by *underlap*). Then in order to match the achievements of worm theory, specifically, its account of temporal predication, the stage theorist should be able to point to exactly the same reasons as evidence that x and y are temporal counterparts. Given (DU), this implies counterpart universalism.

IV. Problem_A

A tennis ball stage b is just above the net. Is it traveling across the court? Inspecting b will not produce an answer. But this is only to be expected (see above). Fortunately, b is not isolated: this stage is surrounded by preceding and succeeding object stages – tennis-ball-stages as well as tomato-stages. b bears the counterpart relation R_b to the former, and a different such relation R_{tb} to the latter. In virtue of R_b , b is now traveling across the court. In virtue of R_{tb} , however, it is not (supposing the neighboring tomato-stages to be sitting still in a grocery store). But b is the tennis ball, a familiar object. It would appear that it must have a determinate lingering property; it must be either traveling or not traveling across the court.

Similarly, Leo Tolstoy must have a determinate property, at a certain instant in 1867, of writing *War and Peace*. He may not both have this property, in virtue of standing in the appropriate counterpart relationship to neighboring person-stages, and at the

same time lack it, in virtue of standing in a different such relationship to cucumber-stages. There is a problem here. And a fairly general one: many, if not all object-stages turn out to have incompatible lingering properties in virtue of different counterpart relations they bear to preceding and succeeding objects stages. Let us refer to the general problem as Problem_A.

A similar problem arises for historical properties. A certain poker-stage has the property *having been hot two hours ago*, because of the counterpart relation it bears to a red-hot past poker-stage, as well as the property *having been cold two hours ago*, because of a different such relation to a past ice-cube-stage. The problem (real or apparent – see below) is essentially the same. But it is more clearly seen in the case of lingering properties, because their possession places a restriction on the object's current state, and, in many cases, on its state at infinitesimally close times. Attribution of historical properties does not, on the face of it, place such restrictions – for the universalist, that is. Nothing in the present state of a cucumber can disqualify it from having been manufactured in Hoboken or even from having written *War and Peace*. But even the universalist must agree that no cucumber-stage can be *writing 'War and Peace'* simply in virtue of standing in appropriate counterpart relations to immediately preceding and succeeding stages of Leo Tolstoy. Only objects having very special momentary physical states and composition qualify. I shall henceforth focus, for the most part, on lingering properties.

V. Sortal Modification

It must be acknowledged that in its initial formulation, the Problem_A for stage universalism is merely apparent. This problem was that object-stages have lingering properties in virtue of standing in counterpart relations to neighboring stages, and since according to (DU) no such relation is ontologically privileged, the ascription of lingering properties becomes generally problematic and sometimes contradictory. One should not forget, however, that

lingering properties, such as *traveling across the court*, *growing in the garden*, or *writing 'War and Peace'*, are possessed by things falling under *sorts*, such as *ball*, *garden plant* and *person*. It is reasonable to suppose that if the thing in question does not fall under the appropriate sort, it cannot have the corresponding lingering property. Nothing can be growing in the garden unless it is a garden plant, and nothing could be writing *War and Peace* unless it is a person.¹⁴ According to stage theory, the kind of things that fall under sorts are, of course, momentary object-stages. But it is plausible to insist that they cannot do so unless they stand in appropriate relations to other stages – their predecessors and successors. No stage can be a cucumber unless (i) it has the requisite physical composition and state, and in addition, (ii) stands in a counterpart relationship to other cucumber-stages, which are themselves endowed with appropriate state and composition. In this respect, sortal properties are similar to lingering and historical properties. Indeed, sortal properties may be *reducible* to complex combinations of intrinsic, lingering and historical properties, such as *being cucumber-shaped*, *producing cucumber seeds*, and *having originated from a cucumber seed*. But I need not legislate on the issue of reducibility of sortal properties. The only point important here is that instantiation of a sortal property (however it is analysed) by an object stage requires standing in a relevant counterpart relationship to other such stages. And the relationship relevant to it appears to be the same relationship that also accounts for the instantiation of lingering properties.

If this is correct then attribution of a lingering property to a single object-stage involves more than meets the eye. The

¹⁴ Cf. D. Armstrong, 'Identity Through Time', in P. van Inwagen (ed.), *Time and Cause* (Dordrecht: Reidel, 1980), pp. 67–78, at pp. 74ff. Sortal restriction may also be at work in other forms of predication of properties in worm and stage theories, e.g., those involving quantifiers and those assuming maximality of temporally extended objects. For critical discussion of sortal restriction strategies in these contexts, see A. Varzi, 'Perdurantism, Universalism, and Quantifiers', *Australasian Journal of Philosophy*, 81 (2003), pp. 208–15; T. Sattig, 'Temporal Predication with Temporal Parts and Temporal Counterparts', *Australasian Journal of Philosophy*, 81 (2003), pp. 355–68.

question ‘Is LT (a Leo-Tolstoy-stage) writing *War and Peace*?’ is a question about LT’s lingering property. But LT possesses this property in virtue of standing in an appropriate relation to the surrounding object-stages, which relation also endows LT with the requisite sortal property (i.e., *being a person*). In effect, sortal restriction works to filter out irrelevant counterpart relations, such as one linking LT to the surrounding cucumber-stages, as well as numerous other ‘unnatural’ relations. And after this work is done, there will be a definite answer to the question whether LT is writing *War and Peace*. In more formal terms, since questions about possession of lingering properties by stages are implicitly sortal-restricted, the answers to them must take sortally modified truth-conditions. Object o_t (i.e., a t -stage) cannot have P_L unless o_t ’s counterparts that are P_L -related to it are also K -related to it, where K is the relevant sortal property.

Sortal restriction is a familiar phenomenon. An object can and will survive squashing *qua* lump of clay but not *qua* statue. The same object can and will survive chopping off a small bit of clay *qua* statue but not *qua* lump of clay. Stage theory explains this by noting that predicates associated with certain modal and historical properties are equivocal: they pick out different properties in different contexts because they latch onto different types of counterpart relations. The stage theorist could note that the same is true of lingering properties. A single object-stage may be (1) undergoing destruction *qua* statue, and (2) not undergoing destruction *qua* lump of clay, because there is no single property that (1) attributes to, but (2) withholds from, the object-stage in question.¹⁵

The idea then is clear. But it needs to be made more precise. First, Problem_A, as stated above, is about properties, not predicates: it concerns not what we should *say* about the instantaneous state of motion of a tennis ball, but rather that state itself. Problem_A, in other words, is ontological and not merely linguistic. (This presupposes a modicum of realism about

¹⁵ Cf. Sider, p. 200.

properties, but not any controversial version of it.) To dissolve the problem successfully, sortal restriction must therefore be regarded as an ontological phenomenon. It has to do not merely with the fact that our temporal discourse is implicitly sortal-restricted, but with the underlying constraints placed by nature on the joint possession of certain sortal and non-sortal properties.

This way of putting it, however, is somewhat arcane, for it brings with it the notion that objects (i.e., object-stages) possess properties only in certain combinations which cannot be taken apart and reassembled differently. Thus o_t can be said to have P_{L_1} and K_1 , as well as P_{L_2} and K_2 , but not P_{L_1} and K_2 , even though there is a clear sense in which it has both these properties. Those enamored of contextuality in quantum theory might perhaps find this attractive: the above constraint on the joint attribution of properties to stages is strikingly similar to the constraint on the joint possession of certain spin-component properties by a quantum particle.¹⁶ But we need not go that far. The ontological mechanism of sortal restriction can be made transparent by treating sorts as *property modifiers*. As a result of such modification, lingering (as well as modal and historical) properties become sortal-indexed. On this view, the lingering properties of o_t include P_{L_1} -*qua*- K_1 as well as P_{L_2} -*qua*- K_2 , but not P_{L_1} -*qua*- K_2 , because there is no such property. Alternatively, sorts could be made to modify the *having* of lingering properties: o_t , for instance, could be said to have P_{L_1} in the K_1 way, or K_1 ly. I shall not pursue this strategy. (Both strategies are suggested by the analogy with temporal modification in the eternalist versions of three-dimensionalism.)

Problem_A is, then, dissolved when it is that apparently incompatible lingering properties are not really incompatible, because, upon inspection, they are not found to be relativized to

¹⁶ On contextuality in quantum theory see, e.g. C. Held, ‘The Kochen-Specker Theorem’, in E.N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2003 Edition), <http://plato.stanford.edu/archives/win2003/entries/kochen-specker>.

the same sort, or are found to be relativized to different sorts. For example, LT (the Leo-Tolstoy-stage) is writing *War and Peace* *qua* person but does not possess in addition the complement of writing *War and Peace* relativized to the *same* sort.

What constitutes a sort for the stage universalist? Perhaps just a certain combination of qualitative properties and temporal counterpart relations a given stage bears to other stages. But in any event, the universalist must recognize many more sorts than we are aware of. Just as there are familiar and unfamiliar fusions, there are familiar and unfamiliar sorts. Diachronic trout-turkeys (objects that fuse earlier years of a trout with later years of a turkey), tomato-ball-tomatoes, and writer-cucumbers all delineate sorts, unfamiliar though they are. Are there any limits whatsoever to be imposed on 'sortal universalism'? I submit that there are.

Ontologically, sorts are in the same category as properties (and perhaps are fully reducible to complex combinations of properties). But sorts are special in that they are *purely qualitative*, which requires that the properties and relations constituting them (or otherwise relevant to their determination) be *non-haecceitistic*: no particular objects, times or places must enter into their constitution. This excludes properties such as *being identical with David Lewis*, *being located at the Greenwich meridian*, and *being 150 meters away from Ned's burning barn*. But for the universalist, this does not exclude properties such as *being located at a region of space filled with matter having local density ρ* , *being 150 meters away from a burning barn*, and *running at 10 m/s away from a growling tiger*. These do not involve relations to particulars, but only to other non-haecceitistic properties and sorts. The restriction to non-haecceitistic properties is, therefore, very modest and by no means deprives the universalist of the freedom to invoke all sorts of sorts entirely unknown to Joe and Jane Sixpack.

Another thing to note about sorts is that they normally form hierarchies, often matching the familiar divisions of determinable and determinate properties. For example, the property *being massive* delineates a very extensive sort including virtually all material objects (photons, gluons and gravitons may be the only

exceptions). The property *having mass m_e throughout its lifetime* (where m_e is the electron's mass), on the other hand, demarcates a much less inclusive sort. Assuming that any hierarchy of determinables and determinates ends at the level of 'ultimate' determinates, it is reasonable to suppose that at least some hierarchies of sorts will end at the level of ultimate 'finest-grained' sorts. It is clear that Problem_A can be considered dissolved as long as it dissolves (via sortal modification of the relevant lingering properties) at *some* level of the hierarchy of sorts. The fact that it may not dissolve at a higher level is immaterial.

Finally, we shall assume that any object whatsoever falls under a sort (indeed, a multitude of sorts). This is a natural assumption to make in the context of universalism, and it gives the stage universalist unhampered access to sortal restriction.

In the next section I argue that while sortal modification provides a good way of dealing with Problem_A as originally stated, it is incapable of dealing with a more sophisticated version of the problem.

VI. Problem_B

For simplicity, return to b , a tennis-ball-stage above the net. Thanks to sortal modification, b is definitely traveling across the court *qua* tennis ball, for although it is R_{bt} -related to the surrounding tomato-stages in a grocery store, R_{bt} is irrelevant to the ontological determination of b 's lingering properties. The only relevant counterpart relationship is R_b , borne to the neighboring tennis ball stages, in virtue of which b is a tennis ball and is also traveling across the court. What goes into R_b ? At the very least, the relata of R_b must be ball-shaped, made of rubber, and, in general, have all the intrinsic properties necessary for being a tennis ball at a time. But that is not enough, for otherwise, b would be both traveling across the court (*qua* tennis ball, that is), by bearing R_b to its predecessor- and successor-stages, and not traveling anywhere (*qua* tennis ball), by bearing R_b to temporally

neighboring tennis-ball-stages in a sports store. To filter out the latter, R_b must incorporate spatio-temporal and qualitative continuity. But even this is not enough to bar ‘immaculate replacement’ scenarios, in which one object is annihilated and another qualitatively identical one created at exactly the same place and time.¹⁷

More straightforwardly, this condition is not enough to determine the instantaneous state of motion of idealized point-like material objects (as is shown by the ambiguity of the spacetime trajectories resulting from a collision of two qualitatively similar point-like objects). To eliminate problems of this kind, R_p (subscript ‘ p ’ for ‘material point’) must incorporate a broadly causal relation binding together (what we normally take to be) stages of a single object, that of *immanent causation*. Equipped with this causal element, R_p is fit to do the required job of delineating certain sequences of stages as falling under the sort *material point* (or simply *point*) and also determining a given point’s instantaneous velocity, acceleration, and so forth.

These examples suggest that counterpart relations involving immanent causation are distinguished. For the universalist, the distinction of such a relation appears to lie in its ability to demarcate a material sort as finely as is needed to determine the state of motion of its instance. But not all counterpart relations are so well behaved.

Instead of a single material point, consider a continuous array of them stretched along the x -axis throughout the interval $[-T, T]$, and focus on its midpoint ($x = 0$) stage o at $t = 0$. Suppose also that the universe (or at least a fragment of it that may be deemed to contribute, one way or the other, to the counterpart relations between o and the neighboring point-stages) is perfectly symmetrical with regard to reflections relative to the yz -plane.

o is at rest in a given reference frame, for it is R_p -related to the temporally neighboring stages of the midpoint, all located at $x = 0$. R_p is, of course, a causally loaded counterpart relationship in virtue

¹⁷ See, e.g., Armstrong, ‘Identity Through Time’, p. 76.

of which o is an object of a certain sort, a point. According to the stage theorist, the object falling under *point* is, of course, a midpoint *stage* at any $t \in [-T, T]$. All such stages form a class ‘AtRest’ whose members stand in the relationship R_p . (For the worm theorist, on the other hand, the object falling under *point* is the diachronic fusion of AtRest, i.e., the *midline*.)

Now consider two more classes of point stages, MovingLeft^v and MovingRight^v , defined as follows: $x_{\text{MovingLeft}^v}(t) = -vt$, $x_{\text{MovingRight}^v}(t) = vt$, for all $t \in [-T, T]$, where $v > 0$ is a constant. All the MovingLeft^v stages are bound together by a certain relationship R_{-v} (according to (DU), any collection of object-stages from different times is bound by a certain counterpart relationship; see §III above), and, partly in virtue of R_{-v} , fall under a certain sort (I am arguing under the assumption that *every* object falls under a certain sort, or sorts; see §V above). What sort? Not *point*, for that sort is reserved for object-stages unified by the relationship R_p , which is causally loaded, and R_{-v} cannot boast this feature. But it does boast qualitative and spatio-temporal continuity. Furthermore, it includes another determinate property constituted by a relation to another sort, *point*. Roughly, the relational property in question is *moving with constant speed v away from a point* (but see below for important qualifications). The sort partly determined by R_{-v} (and partly by the intrinsic nature of the members of MovingLeft^v , i.e., *being pointlike*) I shall call *voint* (for ‘ v ’).

By parity of reasoning and considerations of spatial symmetry, R_{+v} , which relates the members of MovingRight^v , must delineate the *same* sort (i.e., *voint*). Indeed, o is a voint in virtue of: (i) being intrinsically pointlike, (ii) being spatio-temporally and qualitatively continuous with other voints, and (iii) *moving with constant speed v away from a point* (a characterization to be made more precise below). Both R_{-v} and R_{+v} incorporate (ii) and (iii), thus defining the same sort, *voint*. (More on this in §VII below.)

o is also a point, in virtue of being intrinsically pointlike and standing in R_p to other point-stages. Thus o falls under two different sorts. In fact, it falls under other less fine-grained sorts as

well, defined by such determinables as *moving away from a point*, *moving relative to a point* (but not necessarily away from it), and so forth. But clearly, *voint* and *point* are *ultimate* sorts, in the sense of being grounded in the finest-grained non-haecceitistic determinate properties and relations.

o has a number of lingering properties. The most familiar one has already been mentioned: *being at rest*. In view of sortal restriction, however, this needs to be denoted more carefully as *being at rest qua point* or *having instantaneous zero speed qua point*. In addition to having a particular instantaneous speed (viz., zero and *qua point*), *o* has a different kind of broadly kinematic property *shpeed*, which it instantiates in virtue of being a member of MovingLeft^v and MovingRight^v , in virtue of being a voint. Like speed, instantaneous shpeed is a matter of being at particular infinitesimally close locations at infinitesimally close times. Perhaps, on the widely accepted Russellian, or ‘at-at’, theory of motion, this makes shpeed just as robust as speed. But I need not insist on their identity. Indeed, I can call the physical process in which *o* is involved in virtue of having a particular shpeed *shmotion*, not motion.

How fast is *o* shmoving? Clearly, it is shmoving with constant shpeed v , away from a point. (To redeem a promissory note issued earlier, the characterization of one of the properties defining the sort *voint* must thus be corrected from *moving with constant speed v away from a point* to *shmoving with constant shpeed v away from a point*.) And of course, this is something it is doing *qua voint*. In addition, *o* is also at rest. But *being at rest qua point* (or *having instantaneous zero speed qua point*) is quite compatible with *shmoving qua voint* (or *shmoving with shpeed v qua voint*).

On the other hand, even *qua voint*, *o* is involved in two incompatible states of shmotion: shmoving left and shmoving right. *o* is shmoving left (with shpeed v), in virtue of being $R_{-,v}$ -related to the members of MovingLeft^v . But *o* is also shmoving right (with the same shpeed), in virtue of being $R_{+,v}$ -related to the members of MovingRight^v . Although these two relations demarcate the same physical *sort*, they define physically distinct

states of shmotion. This is a problem. Call it Problem_B, to distinguish it from the original Problem_A.

Although Problem_B is best illustrated with simple kinematic examples, it is sufficiently general. It arises when ultimate (i.e., the most fine-grained) sorts leave room for incompatible sortal-modified lingering properties. Such properties can sometimes be individuated more precisely than sorts. To be sure, situations in which this takes place must involve perfect symmetry of some kind. But they are easy to imagine, as our example shows.

The sort of mismatch exhibited in the above example, between the level at which the sortal identity of an object is determined and the level at which its determinate properties are individuated, is familiar. Having spin $\frac{1}{2}$ is an intrinsic sortal property of many elementary particles (e.g., electrons and protons). This property demarcates a *sub-sort* of the sort *fermion*, comprising all particles with half-integer spin. Associated with this single sortal property, however, are two *incompatible* physical *states* of having spin $\frac{1}{2}$ and spin $-\frac{1}{2}$ along a chosen direction. (These states are incompatible in the sense that any measurement of spin along the chosen direction will exhibit one or the other, but not both. Prior to measurement, a particle could be in a superposition of such states.) Again, two incongruent counterparts, such as the right and left hand may be perfectly identical in all relational intrinsic properties. *Being a hand* (with a certain intrinsic shape) can be regarded as a sortal property. Associated with this single sortal property are, however, two non-sortal manifestations of it found in the left and right hand. A single hand cannot be both. Similarly, a single voint cannot be both shmoving left and right, with shpeed v . (Spin and handedness are mentioned here only for the sake of drawing a useful analogy. They have nothing to do with lingering properties or with mereological universalism.)

VII. Some Objections and Replies

Objection 1. Why not say that R_{-v} and R_{+v} demarcate *different* sorts, *voint+* and *voint-*? After all, R_{-v} and R_{+v} relate different classes of entities. If *voint+* and *voint-* are distinct, then Problem_B goes the way of the initial Problem_A.¹⁸

Reply: given the minimal requirement put on the notion of sort in §V, that sorts be purely qualitative and thus grounded only in non-haecceitistic properties, it is implausible to think that the distinction between left and right could split *voint* into two different sorts. Indeed, the distinction in question does not supervene on any intrinsic features of the situation, which is perfectly symmetrical with regard to reflections relative to the *yz*-plane. The distinction can only be drawn by introducing specific reference devices into the situation (with respect to which one direction could then be designated as ‘left’ and the other as ‘right’) and thus invoking manifestly haecceitistic properties (i.e., relational properties involving relations to such devices). If the purely qualitative nature of sorts is to be maintained, no such properties should be allowed to individuate them.

Again, the kinematic property constitutive of *voint*, viz *shmoving with constant speed v away from a point*, is perfectly non-haecceitistic, as it does not implicate a relation to a particular but only to another sort present in the situation, *point*. Yet one might still doubt whether the distinction between this purely qualitative property and its not-so-purely qualitative partner *shmoving left (right) with constant speed v away from a point* is so great as to disqualify the latter from being a suitable property modifier. After all, does not nature itself distinguish between ‘left’ and ‘right’?

This doubt can be dispelled by considering a slightly more complex situation, involving not a reflection but an axial symmetry. Suppose there is a continuous two-dimensional array of

¹⁸ I thank the referees for impressing upon me the need to address some of the objections in this section.

material points located on the xy -plane and symmetrical with respect to arbitrary rotations of this plane around the center point with co-ordinates $x = 0, y = 0$. (Such an array could, for example, be a circle of a finite radius.) For the centre point-stage o at $t = 0$ one can ask the same questions as before about its state of shmotion (*qua* voint). o is now shmoving, *qua* voint, not just ‘left’ and ‘right’, but at *all* angles α (relative to the positive direction of x , say) away from the point $(0,0)$. It would hardly make sense to maintain that the distinction among the infinite number of angles between 0° and 360° could be grounded in any qualitative aspect of the situation.

Objection 2. If the standards of sortal restriction are so demanding as to exclude the classes of stages ShmovingLeft^v , ShmovingRight^v and $\text{ShmovingAtAngle}\alpha^v$ from demarcating distinct physical sorts, could one not simply abandon the sortal modification strategy altogether and relativize o ’s kinematic properties, not to sorts, but to these classes? Why not say that o is shmoving left with shpeed v , *qua* member of ShmovingLeft^v , and also shmoving right with v , *qua* member of ShmovingRight^v ?

Reply: relativization to classes of stages would, of course, take care of Problem_B, but only at the cost of making lingering properties non-repeatable – which would arguably disqualify them from being suitable candidates for lingering properties, those that characterize what an object is *doing*. Two distinct objects can be doing the same thing. There is a clear sense in which o_0 and o_1 , the $t = 0$ and $t = 1$ stages of the centre point, have the same sortal-modified lingering property *shmoving with constant shpeed v away from a point*. But *shmoving at v -qua-member-of- ShmovingLeft^v_0* and *shmoving at v -qua-member-of- ShmovingLeft^v_1* are different properties, for they involve distinct constituents ShmovingLeft^v_0 and ShmovingLeft^v_1 : the first class includes the stages along the spacetime trajectory originating at o_0 , while the second includes the stages along a different such trajectory originating at o_1 . If properties are to be repeatable across time they cannot be relativized to (nor hence be individuated by) class memberships.

Objection 3. Could they not instead be relativized to *relations* unifying the members of such classes – that is, R_{-v} and R_{+v} (and perhaps R_α) – with the proviso that R_{-v_0} , R_{-v_1} , and so on are the *same* generic relation R_{-v} , thus validating repeatability across time and yet making *shmoving left-qua-related-by- R_{-v}* and *shmoving right-qua-related-by- R_{+v}* compatible?

Reply: but there is no principled way to categorize R_{-v_0} , R_{-v_1} , and so on as the same generic relation R_{-v} and yet maintain the difference between R_{-v} and R_{+v} (and between R_α and R_β for all $\alpha \neq \beta$). Identification of R_{-v} and R_{+v} ‘across reflection relative to the yz -plane’ has, in the presence of perfect reflection symmetry in the universe model under consideration, as much ground as identification of R_{-v_0} , R_{-v_1} , and so on ‘across time’, in the presence of perfect ‘translation-in-time symmetry’. The similarity between the two symmetries is even more obvious in the case of the axially-symmetric universe (considered in reply to objection 1) where the relevant sort of transformation preserving all the intrinsic features of the situation includes rigid rotations of the model universe around the z -axis. Clearly, this *continuous* (as opposed to discrete, in the case of plane reflection) transformation ‘along the α dimension’ is on a par with continuous time translation.

The upshot is that although sortal modification may not be the only way to relativize lingering properties of stages, any other plausible relativizer that allowed such properties to be repeatable across time would also ascribe the *same* index to *shmoving left with shpeed v* and *shmoving right with shpeed v* (or *shmoving at angle α with shpeed v* , for all $\alpha \in [0^\circ, 360^\circ)$), thus failing to make the resulting relativized lingering properties compatible. The objector cannot have the cake and eat it too.

To sum up the discussion so far, the case of *voint* is telling: it shows that although sortal restriction (or any other acceptable relativization strategy) may help the stage universalist to reduce the latitude involved in the attribution of lingering properties to stages, but does not completely eliminate it – unless the restriction works along the joints of nature, as it does in case of *point*.

I suggest that the way to handle Problem_B is to take the joints of nature seriously and reject (DU).

VIII. Restricting Diachronic Composition

Rejecting (DU) means condemning numerous fantastic creatures – ball-tomatoes, writer-cucumbers, and voints – to where they truly belong: the realm of non-being. No voints, no Problem_B. In the hands of the stage theorist, the claim that there are no voints amounts to denying the existence of the counterpart relations R_{-v} and R_{+v} and hence the existence of shpeed. Similarly for ball-tomatoes and the like. In the hands of the worm theorist, the claim boils down to denying the existence of the corresponding diachronic fusions. The foregoing discussion suggests a clear reason for this. Such entities are not causally bound: their later states (i.e., the states of their later stages) do not depend on their earlier states.

But rejecting the existence of diachronic ‘monsters’ (or, equivalently, rejecting arbitrary temporal counterpart relations) means imposing a restriction on composition, and any such proposal is threatened by a battery of familiar objections, the chief among them having to do with vagueness. In the remainder of this section I indicate briefly how restricting *diachronic* composition can be sheltered from such objections.

The crucial point here is to realize that diachronic and synchronic composition have different ontological grounds, causal versus non-causal, and that separating their alleged package deal simply follows the joints of nature. If that is the case, then rejecting (DU) does not put upon the advocate of (4D) the burden of providing a theory of restricted synchronic composition. One should view the causal restriction on diachronic composition as operating, first and foremost, at the microlevel:

(RDC) A class of atom stages from different times $\{o_{\text{atom}}(t), t \in T\}$ has a (diachronic) fusion only if its members are related by immanent causation.

A full account of (RDC) would include an explication of the notion of immanent causation appropriate to (4D).¹⁹ But the general idea of the dependence of the physical states of later object-stages on the physical states of earlier stages should be clear.

Three outstanding problems are ordinarily taken to threaten any attempt to restrict composition: (a) under what conditions does a certain class of atoms at t have a fusion at t ? (b) when does a certain object begin and cease to exist? (c) under what conditions is a certain fusion at t_1 identical, or genidentical, with a certain fusion at t_2 ? None of these problems afflicts mereological atoms. And as far as composite objects are concerned, (RDC) is never under attack either, for (a) is explicitly, and (b) and (c) are implicitly, about synchronic, not diachronic, composition. Indeed, (b) can be read as a question about the range of times T such that at any $t \in T$, there is a class of atoms composing-at- t a given object. And (c) can be viewed as the question about what parts an object can lose or have replaced without ceasing to be itself. The answers to both may be vague. But this is not to be blamed on (RDC). A certain composite object may or may not survive a loss, acquisition or scattering of spatial parts, but this has nothing to do with the question of what atom-stages at t_2 are pairwise immanent-causation-related to what atoms-stages at t_1 . Restricted diachronic composition is never vague at the microlevel. The problem of vagueness is quite orthogonal to it.

But this problem constitutes by far the strongest reason to adopt universalism across the board. Given that this pressure is

¹⁹ One difficulty is that causal connectedness may vary in degree depending on the temporal distance between the corresponding stages and perhaps vanish altogether for stages that are very far apart. For a comprehensive analysis of immanent causation in terms of nomic subsumption of events, see D. Zimmerman, 'Immanent Causation', in J.E. Tomberlin (ed.), *Philosophical Perspectives*, Vol. XI (Oxford: Blackwell, 1997), pp. 433–71.

now deflected away from (DU), and that (DU) faces a problem of its own (i.e., Problem_B), I submit that (DU) should be rejected.

IX. Another Objection and Reply

In conclusion, I wish to consider another objection, coming from the celebrated fission scenario.²⁰ Suppose ‘Ted’ names the last pre-fission person-stage which, along with its predecessors, has everything it takes to be writing a book. (I assume, for simplicity, that the notions of the last pre-fission stage and the first post-fission stage make sense.) Ted is then split into Ed and Fred; Ed continues writing the book while Fred does not. What are we to say about Ted? Is he writing a book or not? It appears that we have a Problem_A here, as well as a Problem_B, if we take account of sortal restriction. Moreover, a broadly causal connection, which was above claimed to be crucial to restricting diachronic composition, is in place in both Ted’s ‘branches’. But restricting diachronic composition does not eliminate the problem: Ted is both writing and not writing the book. So it is everyone’s problem, afflicting the restrictivist as well as the universalist. And everyone’s problems often turn out to be no one’s problems.

My reply here is to resist the above description of the case. It is not possible to maintain *both* that the causal connection is in place *and* (all other things being equal) that the last pre-fission stage of Ted is engaged in writing a book while the first post-fission stage of Fred is not. It would be like saying that the Earth suddenly stopped orbiting the Sun. Whatever the nature of the causally loaded personal counterpart relationship is, it will ensure that Fred continues Ted’s activity in a small neighborhood of the fission point. Both ‘branches’ of Ted will be affected by the ‘inertial momentum’ of Ted’s writing, immediately after the fission. And that is all that is needed to ensure complete

²⁰ Thanks to Andrew Cortens for this. My presentation of the objection follows his original commentary on an earlier version of this paper.

determinacy in Ted's possession of the *momentary* lingering property *writing a book*. The fact that Ed's and Fred's life trajectories *eventually* diverge to the extent that Ted completes the book but Fred does not is immaterial, for Ted's lingering properties, such as *writing a book*, are only grounded in what goes on in a sufficiently small neighborhood of the fission point.

One might insist that the eventual divergence of Ed's and Fred's trajectories does frustrate the unambiguous ascription of *historical* properties to Ted. He *will have completed the book* and he *will not*. Moreover, he has both incompatible properties *qua* person. And the sort in question is a causal sort recognized by the restrictivist. Hence even the restrictivist confronts a version of Problem_B, after all.

I submit, however, that in this case, the restrictivist could invoke further details of sortal modification implicitly provided by the divergent trajectories of Ed and Fred. In addition to being a person, each of a certain subclass of Ed's future stages has a (non-haecceitistic) property P_B involving a 'book-writing-conducive relation to the environment' (or something like that), while Fred's corresponding stages do not have this property (or have a complement of this property $\neg P_B$). Ted's historical properties then become perfectly compatible when they are relativized to such more fine-grained sorts.

Of course, a similar degree of detail must also be available for the analysis of Ted's lingering properties. But in that case there is no divergence (or no significant divergence; I am considering a small neighborhood of the fission instant) and, hence, it is appropriate to insist that adding further details to sortal modification will not result in sort splitting.²¹

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