Identity in 4D

Thomas Sattig
Washington University in St. Louis

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Four-dimensionalists offer a unified picture of various puzzles about identity over time, including the puzzle of fission, the puzzle of constitution and the puzzle of undetached parts. What unifies the four-dimensionalist approaches to these puzzles is the possibility of temporal overlap—the possibility for distinct continuants to share a common temporal part, or stage. I claim that the unified picture is inconsistent, if there are informative criteria of identity over time. I will show that while temporal overlap is compatible with four-dimensionalist criteria of diachronic composition, temporal overlap is incompatible with any four-dimensionalist criteria of diachronic identity.

1 Co-location and temporal overlap

Four-dimensionalists hold that ordinary continuants have temporal parts, or stages, as well as spatial parts. For each time at which a continuant exists, the continuant has a temporal part, or stage, that exists only at that time. In support of this view, four-dimensionalists point to the explanatory power of the possibility of temporal overlap—of distinct continuants sharing temporal parts—in treating the puzzles of identity over time.[1] Let us consider three prominent puzzles.

Fission
The hemispheres of a person's brain are disconnected and successfully transplanted into two brainless bodies. Each of the resulting persons, Lefty and Righty, is in every way psychologically continuous with the original person. If, as many philosophers believe, psychological continuity determines whether a person at one time is identical to a person at another time, then

[1] See Sider (2001: 152-3).

the pre-fission person seems to be identical to both post-fission products, and hence Lefty and Righty are one. But to say that a person can occupy wholly distinct places at the same time is a distortion of our concept of a person.[2]

Four-dimensionalists following David Lewis try to avoid such a distortion, while holding that psychological continuity determines personal identity, by allowing there to be two co-located pre-fission persons that go their separate ways when the hemispheres are transplanted. Four-dimensionalists further claim that such co-location is no more problematic than co-location of overlapping roads; the two pre-fission persons share a place p at a time t by sharing a common temporal part at t that occupies p.[3]

Constitution

An artist creates a statue using a lump of clay. Once the artistic process is completed, there is a statue and a lump of clay. While the lump existed before the artist went to work, the statue did not. By Leibniz's Law, which says that identical things must share all their properties, it seems to follow that the statue is distinct from the lump of clay that constitutes it. But the statue and the lump occupy the same places at various times. How is co-location possible for ordinary material objects? Do they not crowd each other out?

Four-dimensionalists deny that there is overcrowding, while holding that the statue and the lump are distinct, since the statue and the lump are co-located in a place p at t in virtue of sharing a common stage at t that is the single thing being wholly located in p at t. What seems puzzling at first, is at bottom as unmysterious as co-location by sharing a spatial part, such as the co-location of a road and its sub-segments.[4]

Undetached parts

Tibbles is a cat, whereas Tib consist of all of Tibbles expect for her tail. By Leibniz's Law, Tibbles and Tib are distinct things. Now suppose that Tibbles loses her tail. Since a cat can survive the loss of certain parts, such as tails, Tibbles survives. Moreover, since nothing happens to Tib apart from having something external detached from it, Tib survives as well. Since both Tibbles and Tib survive, distinct things occupy the same place after detachment of the tail. But at most one material object seems to fit into a

[2]See Parfit (1984: 254-55).

[3]See Lewis (1983: 61-3).

[4]See Sider (2001: 5-6).

given place at a given time.

As in the previous two cases, four-dimensionalists approach this puzzle by embracing co-location of distinct material things. After detachment of the tail, Tibbles and Tib occupy the same place p at time t by sharing a temporal part that is the only material thing wholly located in p at t. Thus, Tibbles and Tib are spacetime worms that overlap in temporal parts, which is the temporal analogue of and no more puzzling than their overlap in spatial parts.

In what follows I shall argue that temporal overlap, and hence the four-dimensionalist take on fission, constitution and undetached parts, is incompatible with any four-dimensionalist criteria of identity over time.

2 Criteria of diachronic identity

Under what conditions is a continuant x of kind K that exists at t_1 identical to a continuant y that exists at t_2? An answer to this question is a criterion of identity over time—a criterion of diachronic identity—for Ks. More specifically, to say that there is an informative criterion of diachronic identity is to say that facts of diachronic identity covary with facts about continuants' instantaneous qualitative profiles as well as cross-temporal relations between these profiles. Consider the following principle:

(C0) Necessarily, a continuant x of kind K that exists at t_1 is identical to a continuant y that exists at t_2 iff x-at-t_1 stands in the I-relation for Ks to y-at-t_2.

Here x-at-t_1 and y-at-t_2 are instantaneous qualitative profiles—call them *states*—of x and y, respectively. (C0) is not a criterion of diachronic identity. (C0) is rather a schema that characterizes a criterion of diachronic identity for Ks as an I-relation for Ks. The schema further characterizes an informative criterion, in the sense that it does not presuppose the identity of continuants for which the criterion is designed. The I-relation for Ks is not identity among continuants of kind K. An I-relation holds only among states of continuants, whereas identity holds among states as well as continuants. In asking whether a particular table still exists tomorrow, we are asking whether any states that exist tomorrow are I-related to the present table-state; the present table follows where the I-relation for tables leads. Any criterion of diachronic identity for Ks will thus be a relation that plays the role of I-relation for Ks as defined in (C0).

What is the function of criteria of diachronic identity? A criterion of diachronic identity is a tool for tracking continuants through time, a test, consisting of necessary and sufficient conditions, for determining whether cross-temporal facts of identity obtain, on the basis of instantaneous qualitative states of continuants and cross-temporal relations between these instantaneous states. For illustration of the function of criteria of diachronic identity, suppose that an almost omniscient being A knows all instantaneous qualitative states of any ordinary, macroscopic material object at any time (where a qualitative state of x may involve any attribute of x other than being x), all cross-temporal relations, including causal relations, between these instantaneous states, and the spatiotemporal paths of all fundamental, microscopic particles. So A knows instantaneous facts about ordinary continuants, such as that x has a certain location, shape and microphysical decomposition at t, and that y has a certain location, shape and microphysical decomposition at t*; and A knows cross-temporal facts, such as that x's being such-and-such at t causes y's being-such-and-such at t*. But A does not know any non-instantaneous facts of persistence and identity about any macro-continuants. Those who believe that there are informative criteria of diachronic identity of ordinary continuants, believe that A is able to determine the past and future trajectory of each ordinary continuant at any time, from the facts known to her. For any particular ordinary continuant x at a particular time, A is able to 'locate' x at any other time.

This construal of the function of an informative criterion of diachronic identity is epistemic; the specified covariation allows, in principle, the tracking of a continuant through time. However, the type of criterion characterized in this way is independent of 'evidential criteria', of grounds or evidence on which we ordinarily base our judgements of diachronic identity. The central issue is not what qualitative facts inform and justify our judgements of diachronic identity in ordinary circumstances, irrespective of whether diachronic identity obtains in these circumstances. The issue is rather what qualitative facts are necessary and sufficient for facts of diachronic identity in any circumstances; and the issue is relevant for the task of determining whether diachronic identity really obtains. The specified expectations of informative criteria of diachronic identity are further independent of metaphysical expectations one might have of such criteria, such as that the latter provide an account of the 'nature' of identity over time. Perhaps David Lewis is right that there are no real problems concerning the nature of identity, concerning what identity 'consists in'.[5]Even so, it should in principle

[5]See Lewis (1986: 192-3).

be possible to track identity through time; to specify a reliable test for when it obtains.[6]

As a further point of clarification, notice that (C1) does not characterize a criterion for determining whether a continuant x of kind K that exists at t_1 is identical to a continuant y *of kind* K that exists at t_2. (C1) rather characterizes a criterion for determining whether a continuant x of kind K that exists at t_1 is identical to a continuant y that exists at t_2, irrespective of what kind y belongs to. The reason for this open formulation is simply that we want a criterion of diachronic identity to determine *all* facts of diachronic identity and distinctness, not just facts involving continuants of the same kind. Is the person in front of us now identical to the mountain we climbed last year? The restricted criterion does not address this question at all; it only touches on identity and distinctness of a person at one time and a person at another time. The unrestricted criterion, on the other hand, is designed, for any continuant whatsoever, to speak on the question whether the person now is identical to that continuant. To emphasize, the question whether criteria of identity should be restricted or unrestricted is independent of problems surrounding criteria of kind-membership, including the question whether a continuant can change in kind over time. The issue at hand is entirely one about the scope of the criterion, its domain of application.[7] (I shall turn to substantial problems of kind-membership in Sections 4 and 5.)

It is widely held that the I-relation for any K has a causal component. Irrespective of what kind the object belongs to, its diachronic identity is a matter of causal dependence among its stages. In the case of persons, the central question then becomes whether the lines of causal dependence among states are lines of psychological or of physical/biological continuity. In the case of non-persons, it is common to view the lines of causal dependence among states as lines of qualitative and spatiotemporal continuity. These

[6] Recent skeptics, such as Trenton Merricks (1998), raise doubts about the purpose of criteria of diachronic identity. As should be apparent from the remarks above, I think that the skeptical challenge can be resisted. But this paper is not the place for a detailed stand on this issue.

[7] Eric Olson draws the distinction between the unrestricted, or 'broad', criterion and the restricted, or 'narrow', criterion in (1997: 25-6). He adds, though, that if the concept of a person is a substance concept—that if something is a person at one time, then it is a person throughout its life—then the restricted criterion is equivalent to the unrestricted one, for the substitution of 'K' by 'person'. This is incorrect. For even on the mentioned assumption, the restricted criterion does not cover all questions of diachronic identity and distinctness about persons, whereas the unrestricted criterion does. The moral is that the question of whether the concept of a person is a substance concept is independent of the question of the scope of a criterion of personal identity.

directions for reductive analyses of the I-relation for certain Ks are only mentioned to be set aside. The arguments to be given in the following sections rest on the general characterization of I-relations given in (C0), without requiring an account of any I-relation for any K.

Our characterization of a criterion of diachronic identity in terms of an I-relation between states of continuants is meant to be neutral on the question whether continuants have temporal parts. If continuants do have temporal parts, then for each instantaneous state of which x is the subject at some time, x has an instantaneous temporal part that is the subject of this state simpliciter. Thus, in a four-dimensionalist world, tracking continuants is a matter of linking stages of continuants, and any I-relation holding between states may be construed as a relation holding between stages. In order to make this explicit, a four-dimensionalist criterion of diachronic identity may be characterized as follows:

(C1) Necessarily, a continuant x of kind K that exists at t_1 is identical to a continuant y that exists at t_2 iff x's stage S_1 at t_1 stands in the I-relation for Ks to y's stage S_2 at t_2.

On this four-dimensionalist schema, a criterion of diachronic identity for Ks is characterized as an I-relation for Ks that holds among temporal parts, or stages, of continuants. In asking whether a particular table still exists tomorrow, we are asking whether any stages that exist tomorrow are I-related to the present table-stage; the present table follows where the I-relation for tables leads. Any four-dimensionalist criterion of diachronic identity for Ks will thus be a relation that plays the role of I-relation for Ks as defined in (C1). In what follows, I shall work with (C1). It should be emphasized, however, that the arguments to be given in Section 4 may be equally premised on (C0) under a four-dimensionalist interpretation.

3 Criteria of diachronic composition

Criteria of diachronic identity must be distinguished from criteria of diachronic composition. According to four-dimensionalism, a continuant is composed of instantaneous stages. Which mereological sums of instantaneous stages count as a continuant of a certain kind K? An answer to this question is a criterion of composition over time—a criterion of diachronic composition—for Ks. A criterion of diachronic composition is a way of sticking together stages so that they form a continuant. Four-dimensionalists usually say that a mereological sum counts as a continuant if it is the biggest

sum of stages such that each stage in the sum stands in a certain unity relation—a U-relation—to all other stages in the sum (and to itself).[8]

Somewhat more carefully, a U-relation is, first of all, a criterion for determining, for any two stages, whether these stages belong to a continuant of some kind:

(C2) Necessarily, there is a continuant of kind K of whom S_1 and S_2 are stages iff S_1 stands in the U-relation for Ks to S_2.

However, (C2) is not yet a criterion of diachronic composition for Ks. For (C2) specifies under what conditions, for any pair of non-simultaneous stages, there is an object of kind K that has the two stages as parts. A full-blown criterion of composition, on the other hand, specifies under what conditions, for any set of stages, there is an object of kind K that is composed of the stages in the set, where x is composed of the stages in set s just in case every member of s is a part of x, and every part of x overlaps some member of s. While (C2) by itself does not amount to a full-blown criterion of composition, (C2) forms the basis of such a criterion, in the sense that a proper criterion of diachronic composition can be arrived at by extending (C2) in the following way:

(C3) Necessarily, there is a continuant of kind K composed of stages S_1, S_2,..., S_n iff S_1, S_2,... S_n are maximally interrelated by the U-relation for Ks.

The task of specifying an informative criterion of diachronic composition for Ks is thus the task of specifying a relation that plays the role of U-relation for Ks as defined in (C3).

As regards the interaction between the U-relation for Ks and the I-relation for Ks—where 'U-relation for Ks' and 'I-relation for Ks' are functionally defined labels—it is expected (but not necessary) that whichever relation plays the role of U-relation for Ks—whichever relation is a criterion of diachronic composition for Ks—also plays the role of I-relation for Ks—is also a criterion of diachronic identity for Ks.

There is an important difference between the I-relation, as characterized by schema (C1), and the U-relation, as characterized by schemata (C2) and (C3). The I-relation is a tool for tracking a continuant through time. Given a particular object x of kind K at a particular time—that is, given a particular stage of x—and given an I-relation for Ks, we are able to 'locate'

[8] See Lewis (1983: 59).

x at any other time. The U-relation, on the other hand, is a tool for building a continuant out of stages existing at different times. The U-relation for Ks tells us when various stages belong to and compose some one continuant of kind K. But the U-relation does not tell us how to track a particular continuant through time. Given the fact that table a exists at a certain time, neither (C2) nor (C3) address the question whether a still exists at a later time, and which continuant at that time a is identical to. (C2) grounds the fact that our universe contains a continuant of kind K with stages S_1 and S_2 as parts, whereas (C3) grounds the fact that our universe contains a continuant of kind K that is composed of stages S_1, S_2,..., S_n. But neither (C2) nor (C3) is meant to determine any facts about particular continuants—specifically, (C2) and (C3) do not allow the determination of facts of diachronic identity and distinctness about continuants, which is the job of (C1).

This difference between criteria of diachronic identity and criteria of diachronic composition is easily missed or underplayed. Lewis, for example, asks what it takes for a person who exists at one time to be identical to someone who exists at another time:

> In wondering whether you will survive the battle, you wonder whether you—a continuant person consisting of your present stage along with many other stages—will continue beyond the battle. Will you be identical with anyone alive then?[9]

This is a classic question of personal identity, a question demanding a criterion of diachronic identity, what I have characterized as a criterion for tracking a particular person through time. Lewis then connects this classic question with a question about stages in the following way:

> S_1 and S_2 are I-related [...] if and only if there is some one continuant person of whom both S_1 and S_2 are stages.[10]

This schema, however, merely characterizes a criterion of diachronic composition, which is incapable of tracking a person through time. That there is some person containing both my present stage and a stage after the battle does not determine whether I will survive the battle.[11]

The difference between criteria of diachronic identity and criteria of diachronic composition bears heavily on the prospects of temporal overlap.

[9] Lewis (1983: 58-9).
[10] Lewis (1983: 61).
[11] See Perry (1975: 8-9) for a similar confusion.

In the following section, I shall give two arguments for the incompatibility of temporal overlap with criteria of diachronic identity as characterized in (C1).

4 Diachronic identity and temporal overlap

For any continuant x of kind K that has S_1 as a stage, and any stage S_2 at time t that stands in the I-relation for Ks to S_1, (C1) not only entails (i) that x is identical to *some* continuant that has S_2 as a stage, but also (ii) that x is identical to *any* continuant that has S_2 as a stage. The first consequence concerns the issue whether x exists at t, whereas the second consequence concerns the issue *which* continuant existing at t x is identical to. The reason why we want (C1) to entail (ii) as well as (i) is that we want the I-relation to track facts of diachronic identity as well as facts of diachronic existence.

I shall give two arguments for the incompatibility of (C1) and temporal overlap. The first argument arises from consequence (i) of (C1), and the second argument arises from consequence (ii) of (C1). Assuming that continuants x and y are co-located at a certain time, the first argument addresses the problem of explaining how x and y can go separate ways—that is, how x's and y's lines of persistence can diverge—whereas the second argument addresses the problem of explaining how a continuant at a different time can be identical to x rather than y.

Before turning to these arguments, notice that temporal overlap is compatible with (C2) and (C3)—that is, temporal overlap is compatible with the availability of criteria of diachronic composition. In the case of fission, there is temporal overlap of distinct things belonging to the same kind in virtue of distinct sets of stages sharing several stages in common and being each maximally interrelated by the same U-relation. In the cases of constitution and undetached parts, there is temporal overlap of distinct things belonging to different kinds in virtue of distinct sets of stages sharing several stages in common and being each maximally interrelated by different U-relations.[12]

[12]It is worth pointing out that changing the left-hand side of (C2) to 'necessarily, there is a *unique* continuant of kind K of whom S_1 and S_2 are stages' immediately rules out temporal overlap of distinct things belonging to the same kind, but still allows temporal overlap of distinct things belonging to different kinds. However, changing the left-hand side of (C3) to 'necessarily, there is a *unique* continuant of kind K composed of stages S_1, S_2,..., S_n' does not rule out temporal overlap of distinct things belonging to the same kind. In fact, this strengthened version of (C3), incorporating a uniqueness claim, belongs to the inventory of standard four-dimensionalism.

First incompatibility argument
For any continuant x that belongs to a kind K and has a stage S_1, and any stage S_2 that stands in the I-relation for Ks to S_1, (C1) entails that x has S_2 as a temporal part (consequence (i)). It follows that there cannot be distinct continuants of kind K that overlap in S_1 but not in S_2. Since S_1 and S_2 are I-related, any continuant that has S_1 as a temporal part, also has S_2 as a temporal part. Intuitively speaking, it is not possible for distinct continuants of the same kind to overlap in S_1 and yet to go separate ways, since any continuant of kind K that has S_1 as a stage goes where the I-relation for Ks leads.

In the case of personal fission as construed by four-dimensionalists there is a person, Lefty, that has stages S_1 and S_2 as parts, and there is a distinct person, Righty, that overlaps with Lefty in S_1 but not in S_2, which means that Righty has S_1 but not S_2 as a temporal part. This temporal overlap of persons is incompatible with (C1). Lefty's stages S_1 and S_2 stand in the I-relation for persons. According to (C1), if S_1 stands in the I-relation for persons to S_2, then any person that has S_1 as a part is identical to a continuant that has S_2 as a part—in short, any person that has S_1 as a part also has S_2 as a part. Assume for reductio that Righty has S_1 but not S_2 as a part. Since S_1 stands in the I-relation for persons to S_2, it follows by (C1) that Righty is identical to a continuant that has S_2 as a part—in short, Righty has S_2 as a part—which contradicts our assumption.

This result should worry four-dimensionalists. Four-dimensionalists say that there are two persons before fission, Lefty and Righty. Lefty wakes up in the left post-operation room. But why does Lefty not wake up in the right room, as opposed to the left one? What happens during the operation that determines one path for Lefty rather than another one? Cross-temporal *de re* questions of this type are sensible questions, questions at the heart of traditional debates about personal identity. Some say that there is one person before fission, and that this person dies in the operation because it follows a line of biological continuity, or because it does not follow a non-branching line of psychological continuity. Others say that it is indeterminate whether the pre-fission person survives because it is indeterminate whether it follows a line of psychological/biological continuity reaching beyond the operation. Each of these views is able to give an account of its projected outcome for any particular person. Four-dimensionalism is unable to do so. What a criterion of type (C2)—a criterion of diachronic composition—can offer is an account of whether there is *some* pre-fission person that wakes up in the left room. But it does not tell us whether this person is Lefty. Only a criterion of type (C1)—a criterion of diachronic identity—can shed light on what

happens to Lefty. But the availability of such a criterion is incompatible with temporal overlap.

The first incompatibility argument establishes the incompatibility of temporal overlap of distinct things belonging to the same kind with (C1). It seems that temporal overlap of distinct things belonging to different kinds, allegedly present in the cases of constitution and undetached parts, is immune to this incompatibility argument. Suppose that continuants x and y share stage S_1 but belong to different kinds, say K and K*—for example, 'statue' and 'lump of clay'. Suppose further that S_1 stands in the I-relation for Ks to S_2, but fails to stand in the I-relation for K*s to S_2. Since x is a K, it follows by (C1) that x has S_2 as a temporal part. Since y is a K*, and S_2 does not stand in the I-relation for K*s to S_1, (C1) does not have the consequence that S_2 is a temporal part of y. Since there may be different I-relations corresponding to different kinds, distinct continuants of kinds K and K* may temporally overlap, while one continuant follows the I-relation for Ks, and the other continuant follows the I-relation for K*s. The moral is that tracking a continuant through time is meant to be sensitive to the kind to which the continuant belongs. This is why the first incompatibility argument appears to be restricted to temporal overlap of distinct things belonging to the same kind, which form of temporal overlap four-dimensionalists put to work in resolving the puzzle of fission. In Section 5, I will show that this restriction is an illusion.

Second incompatibility argument
Given that a continuant x of kind K has S_1 as a stage, and given that S_1 stands in the I-relation for Ks to S_2, (C1) entails that x is identical to any continuant y that has S_2 as a stage, irrespective of which kind y belongs to (consequence (ii)). Thus, it is not possible for distinct continuants to overlap in S_2. The crux is that the I-relation tracks x through time; starting from x at a given time, determining which continuant existing at another time is identical to x is entirely a matter of determining where the I-relation leads. The I-relation, however, being a relation among stages, is not capable of distinguishing between distinct continuants sharing the same stage.

This argument applies to temporal overlap of distinct things belonging to the same kind, and hence applies to the case of fission as construed by four-dimensionalists, just as the first incompatibility argument does. Let us focus, however, on the application of the present argument to temporal overlap of distinct things belonging to different kinds, which form of temporal overlap four-dimensionalists put to work in resolving the puzzle of constitution and the puzzle of undetached parts.

In the case of constitution as construed by four-dimensionalists there is a lump of clay that has stages S_1 and S_2 as parts, and there is a statue, distinct from the lump, that overlaps with the lump in S_2 but not in S_1, which means that the statue has S_2 but not as S_1 as a temporal part. This temporal overlap of statues and lumps of clay is incompatible with (C1). The lump's stages S_1 and S_2 stand in the I-relation for lumps of clay. According to (C1), for any lump of clay x that has S_1 as a temporal part and any continuant y that has S_2 as a temporal part, x is identical to y if S_1 and S_2 stand in the I-relation for lumps of clay. Assume for reductio that the statue has S_2 as a part and is distinct from the lump. Since S_2 stands in the I-relation for lumps to S_1, and since the statue has S_2 as a part—the statue's stage at t_2 is identical to the lump's stage at t_2—it follows by (C1) that the lump of clay that exists at t_1 is identical to the statue that exists at t_2, which contradicts our assumption that the lump and the statue are distinct.

Analogously for the case of Tibbles and Tib. Tibbles' stages S_1 and S_2 stand in the I-relation for cats. According to (C1), for any cat x that has S_1 as temporal part and any continuant y that has S_2 as a temporal part, x is identical to y if S_1 and S_2 stand in the I-relation for cats. Assume, then, that Tib has S_2 as a stage and is distinct from Tibbles. Since S_2 stands in the I-relation for cats to S_1, and since Tib's stage at t_2 is identical to Tibbles' stage at t_2, it follows by (C1) that the cat that exists at t_1, Tibbles, is identical to Tib, which contradicts our assumption that Tibbles and Tib are distinct.

Recall that temporal overlap of distinct continuants belonging to different kinds appeared to be immune to the first incompatibility argument. If continuant x shares with a distinct continuant a stage S_1 that bears the I-relation for Ks to stage S_2 and the I-relation for K*s to a further stage S_3, then x has S_2 as a temporal part just in case x is a K, and x has S_3 as a temporal part just in case x is a K*. That is, x's kind selects a certain I-relation that tracks x through time, and thereby selects the right continuant in the case of temporal overlap.

The four-dimensionalist might similarly appeal to kind-membership in order to block the second incompatibility argument in cases of temporal overlap involving things of different kinds. Given that a continuant x of kind K has S_1 as a stage, and given that S_1 stands in the I-relation for Ks to S_2, (C1) entails that x is identical to any continuant y that has S_2 as a stage, irrespective of which kind y belongs to. In order to avoid the resulting incompatibility with temporal overlap in S_2, the four-dimensionalist might say that a continuant x of kind K is identical to a continuant y only if

y belongs to kind K as well. The suggestion, then, is to add a necessary condition to (C1), to the effect that y belong to the same kind as x. If x belongs to kind K and the I-relation for Ks leads to a stage of distinct continuants, one of which belongs to K, whereas the other does not, then x is identical only to the one that belongs to K. Again, x's kind is assigned the role of selecting the right continuant in the case of temporal overlap.

5 Kind-membership and circularity

These responses to the first and second incompatibility arguments, as applied to the case of temporal overlap of things belonging to different kinds, both employ membership of a certain kind in tracking facts of identity over time. This strategy fails on the common assumption that facts about membership of kind K depend on more basic facts about the instantiation of K-determining properties. First, let us distinguish between temporally sensitive and temporally insensitive criteria of kind-membership:

(i) A continuant x belongs to a kind K at a time t iff x has certain K-determining properties at t.

(ii) A continuant x belongs to kind K iff x has certain K-determining properties at all times at which it exists.[13]

When four-dimensionalists describe such cases as the statue and the lump of clay as cases in which distinct continuants belonging to different kinds share a common stage, they typically assume the temporally insensitive criterion given in (ii). When the statue and the lump temporally overlap at t, then they share a stage at t that has both statue-determining properties and lump-determining properties simpliciter. Accordingly, both continuants have statue-determining as well as lump-determining properties at t. By the temporally sensitive criterion (i), each of the overlapping continuants is a statue as well as a lump at t. Four-dimensionalists, however, want to say that only one continuant is a statue, whereas the other is a lump. This description requires criterion (ii): one continuant is a statue in virtue of having statue-determining properties throughout its life—each of its stages has statue-determining properties simpliciter—whereas the other continuant

[13]Temporally insensitive criteria of kind-membership are usually construed as modally insensitive as well: a continuant x belongs to kind K iff x has certain K-determining properties at all times and all possible worlds at which it exists.

is a lump of clay in virtue of having lump-determining properties throughout its life—each of its stages has lump-determining properties simpliciter.

Furthermore, it is obvious that temporally sensitive kinds as construed in (i) cannot be of any help in tracking facts of diachronic identity in cases of temporal overlap. If continuants x and y overlap in stage S_1 at t, and S_1 is a relatum of distinct I-relations, then x's kind at t is incapable of selecting the right I-relation for x, since, for any kind K, x belongs to K at t just in case y belongs to K at t.

Are temporally insensitive kinds as construed in (ii) better suited for the job of rendering criteria of diachronic identity compatible with temporal overlap? No. Determining whether continuant x has K-determining properties at all times of its existence, and hence whether x is a K according to (ii), depends on determining at which times x exists—to put it in stage talk, determining whether x is composed of stages each of which has K-determining properties simpliciter depends on determining which stages x is composed of. To determine at which times a continuant exists is the purpose of criteria of diachronic identity. Thus, the temporally insensitive criterion of kind-membership given in (ii) presupposes criteria of diachronic identity. But then it would be circular to invoke kind-membership in specifying criteria of diachronic identity. In short, tracking a continuant from a time t must not presuppose any information about what the continuant is like at any time other than t.

Let us evaluate the mentioned responses to the first and second incompatibility arguments with respect to this threat of circularity. As regards the first argument, consider again the following case of temporal overlap. Stage S_1 bears one I-relation to a distinct stage S_2, and a different I-relation to a further stage S_3. Moreover, continuant x has S_1 and S_2 but not S_3 as temporal parts. The suggestion was that x's belonging to a certain kind selects one of the two I-relations as the one that tracks x through time, and thereby selects S_2 as opposed to S_3 as a temporal part of x. The reason why kind-membership as construed in (ii) is incapable of playing this role in tracking continuants is that kind-membership rests on cross-temporal facts of diachronic identity. As a consequence, there is no way of selecting a particular I-relation in the above case of temporal overlap. So the first incompatibility argument stands, both in the case of temporal overlap of distinct continuants of the same kind and in the case of temporal overlap of distinct continuants of different kinds.

In this context, it is necessary to add a word on the status of (C1). The possibility for S_1 to be the relatum of multiple I-relations makes (C1) untenable as a characterization of a criterion of diachronic identity, since (C1)

renders diachronic identity sensitive to kind-membership. The reason why the first incompatibility argument does not arise for (C1) is that according to this schema, x's kind selects the right I-relation. As we have seen, kind-membership may not be assigned this function on pain of circularity. How, then, may (C1) be reformulated in the presence of temporal overlap, such that sensitivity of identity criteria to kind-membership is removed. There seem to be two directions: if continuant x's stage S_1 is a relatum of multiple I-relations, then (1) x follows *any* I-relation that S_1 bears to any other stage, or (2) x follows *no* I-relation that S_1 bears to any other stage. According to (1), x has both S_2 and S_3 as temporal parts. According to (2), x has neither S_2 nor S_3 as temporal parts. Both results contradict the initial assumption that x has S_2 but not S_3 as a temporal part.

It should be emphasized, however, that (C1) is misleading only on the assumption that temporal overlap is possible, and hence that S_1 can be a relatum of multiple I-relations. If, on the other hand, temporal overlap is impossible, and S_1 is invariably a relatum of a unique I-relation, then (C1) remains acceptable as a characterization of a criterion of diachronic identity. For in this case x's belonging to kind K will not have the function of selecting one I-relation out of many. Instead, x's belonging to K may be seen as a consequence of x's path being determined by the I-relation for Ks, where the latter may be understood as a relation that tracks the propagation of K-determining properties.

As regards the second incompatibility argument, consider again the situation in which x belongs to kind K and the I-relation for Ks leads from x's present stage to a stage of distinct continuants, one of which belongs to K, whereas the other does not. The suggestion was to assign x's kind the role of selecting the right continuant, to the effect that x is identical only to the one that belongs to K. The problem with this suggestion is that, assuming temporally insensitive criteria of kind-membership, determining whether x belongs to a certain kind presupposes information on which of the two continuants is identical to x, since kind-membership is based on facts of diachronic identity. As a consequence, there is no way of selecting a particular continuant in the present case of temporal overlap. Therefore, the second incompatibility argument goes through, both in the case of temporal overlap of distinct continuants of the same kind and in the case of temporal overlap of distinct continuants of different kinds.

The circularity in the responses to my incompatibility arguments is a consequence of the view that facts about membership of kind K depend on more basic facts about the instantiation of K-determining properties. The circle may be broken by rejecting this view and construing kind-membership

as metaphysically brute. Since kind-membership, according to brutism, does not rest on cross-temporal facts of identity, kinds may be assigned the function of selecting a particular I-relation in order to track temporally overlapping continuants through time. So brutism about kind-membership allows four-dimensionalists to escape the incompatibility arguments, as applied to the case of temporal overlap of things belonging to different kinds. The construal of facts about kind-membership as ground-level facts, however, represents a modification of the standard four-dimensionalist package which most friends of temporal parts will presumably regard as undesirable.

As a last point on the subject of circularity, it should be added that invoking kind-membership in modifying (C1) is not the only way of responding to my incompatibility arguments by defeating the purpose for which (C1) is designed, namely the purpose of offering a qualitative test for diachronic identity. Consider the following modification of (C1), which might be claimed to render criteria of diachronic identity compatible with temporal overlap:

(C1*) Necessarily, a continuant x of kind K that exists at t_1 is identical to a continuant y that exists at t_2 iff each of x's stages (at any time at which x exists) stands in the I-relation for Ks to each of y's stages (at any time at which y exists).

While (C1*) is compatible with temporal overlap, (C1*) cannot do the work a criterion of diachronic identity is supposed to do. The reason is that determining, on the basis of (C1*), whether x, identified at t_1, is identical to anything at t_2 requires determining at which times other than t_1 x exists. Tracking a continuant from a time t, however, must not presuppose any information about what the continuant is like at any time other than t.

6 Synchronic identity and spatial overlap

Criteria of identity over time as defined by (C1) have a spatial analogue:

(C4) Necessarily, a continuant x of kind K that has a spatial part P_1 at t is identical to a continuant y that has a spatial part P_2 at t iff P_1 stands in the spatial I-relation for Ks to P_2.

Principle (C4) is a schema for criteria of identity over space, for tracking an object through space at the same time by relations between spatial parts of the object, just as (C1) is a schema for criteria of identity over time, for

tracking an object through time by relations between temporal parts of the object.

Criteria of identity over space at the same time as defined by (C4) are incompatible with spatial overlap, the sharing of a spatial part by distinct objects at the same time. Suppose that distinct highways, Northy and Southy, share their segment west of north-south line l, while east of l Northy bends to the north and Southy bends to the south. This case is a spatial analogue of the temporal case of personal fission as construed by four-dimensionalists. Northy has (at a given time) spatial parts P_1 and P_2, where P_1 is west of and P_2 east of separation line l, and P_1 is related to P_2 by the spatial I-relation for roads. Accordingly, Southy overlaps with Northy in P_1 but not in P_2. By (C4), any road that has P_1 as a part is identical to a road that has P_2 as a part—in short, any road that has P_1 has P_2 as well. Since Southy overlaps with Northy in P_1, it follows that Southy has P_2 as a part as well, which contradicts our assumption. This argument is a spatial analogue of the first incompatibility argument, as applied to the case of personal fission.[14]

Spatial overlap of distinct ordinary objects, as in the case of the roads, is clearly possible. This possibility implies that there are no informative criteria of identity over space. In light of the analogy between the spatial and the temporal case, what reason remains, then, for the four-dimensionalist to be worried about the unavailability of informative criteria of identity over time?

The reason why the four-dimensionalist should continue to worry is that the demand for criteria of identity over time is intuitively much more plausible than the demand for criteria of identity over space. It is a platitude of common sense that ordinary objects exist at different times but (exactly) occupy only a single place at any of these times; in short, ordinary objects persist through time but not through space. We expect to be able to identify and re-identify, to track, ordinary objects across time but not across space because we conceive of ordinary objects as persisting though time but not through space. In the spatial case, it is intuitively clear that what we identify west of separation line l is not the road itself but merely a segment of it. Since road-segments do not occupy multiple places at any time, this segment does not recur east of l. Hence no question arises as to how the segment may be re-identified elsewhere. In the temporal case, on the other hand, it is intuitively clear that what we identify at a pre-fission time is the person itself. And since persons may exist at multiple times, there is a sen-

[14] I am grateful to Cody Gilmore and an anonymous referee for pushing this space-time analogy.

sible question as to how the person may be re-identified at post-operation times.

So the demand for criteria of synchronic identity of type (C4) is an unreasonable one. A sensible alternative is available, however. For it is natural to construe criteria of synchronic identity in terms of relations between temporal parts of continuants:

(C5) Necessarily, a continuant x of kind K that exists at t is identical to a continuant y that exists at t iff x's temporal part S_1 at t stands in the spatial I-relation for Ks to y's temporal part S_2 at t.

The simplest account of synchronic identity among continuants—the simplest reductive analysis of the spatial I-relation—is just numerical identity simpliciter among stages. A more complex account is required, though, if co-location and bi-location—multiple spatial location at the same time—are possible. For if distinct continuants x and y can occupy the same place at the same time, then x and y are distinct despite sharing their stage at this time.[15] Moreover, if a continuant x can occupy distinct places at the same time, then x has numerically distinct stages at this time.

Now back to the threat of incompatibility. Principle (C5), unlike principle (C4), is compatible with spatial overlap. By (C5), the fact that a road x at t is distinct from a road y at t entails the fact that x's stage at t fails to stand in the spatial I-relation to y's stage at t. The latter fact, moreover, is compatible with x's stage at t sharing a common spatial part with y's stage at t. Hence, the availability of a criterion of synchronic identity is compatible with spatial overlap, if such a criterion is characterized by (C5).

The upshot is that our temporal incompatibility arguments have no sensible spatial analogues. Overlap in temporal parts is incompatible with the availability of criteria of diachronic identity, since facts of diachronic identity are tracked by relations among temporal parts. Overlap in spatial parts, on the other hand, is compatible with the availability of criteria of synchronic identity, since facts of synchronic identity are not tracked by relations among spatial parts, but rather by relations among temporal parts.

[15] Given our considerations in previous sections, if co-location by temporal overlap is possible, then cross-temporal facts about particular continuants remain untrackable. Moreover, if co-location by temporal overlap is possible, then cross-temporal facts are the only facts that can be appealed to in distinguishing the continuants at the time of co-location. Since cross-temporal facts are untrackable in the case of temporal overlap, facts of identity and distinctness at the same time are also untrackable in the case of temporal overlap.

7 Conclusion

Under what conditions is a continuant of a certain kind existing at one time identical to a continuant existing at another time? This classic question of identity over time is commonly viewed as sensible and as having an informative answer. If this view is correct, then the four-dimensionalist doctrine that distinct continuants can overlap by sharing stages cannot be upheld. Criteria of diachronic identity thus threaten the four-dimensionalist unified picture of the puzzles of identity over time.

It remains to be pointed out that the scope of this problem stretches beyond four-dimensionalism. Criteria of diachronic identity also threaten the three-dimensionalist picture of certain puzzles of identity over time, according to which distinct objects may spatially and materially coincide. If distinct and coinciding objects share all of their qualitative, categorical properties at the time of coincidence, and if brute facts about kind-membership are rejected, then tracking distinct three-dimensionalist coincidents through time by relations among their instantaneous, qualitative states (see principle (C0)) will be just as impossible as tracking distinct four-dimensionalist coincidents through time by relations among their instantaneous temporal parts. The fact that three-dimensionalist coincidentalism faces problems concerning how an object's temporal trajectory is determined did not play a central role in this paper because this fact is well known. Indeed, only three-dimensionalism has traditionally been subjected to such criticism.[16] And so it was my aim to put four-dimensionalism in the same boat. Classic questions of identity over time are good questions; and such questions are unanswerable in a four-dimensionalist framework with temporal overlap.[17]

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[16] The supervenience problem for three-dimensionalist coincidence is a problem of this type; see Burke (1992) and Zimmerman (1995: 87-88).

[17] Thanks to Cody Gilmore, Ted Sider and an anonymous referee for helpful criticism. Special thanks to Elizabeth Harman for her comments at the 2007 Central Division Meeting of the APA in Chicago.

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