Counterpart theory and the paradox of occasional identity*

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Penultimate draft, final version in Mind *2014*

Counterpart theory is often advertised by its track record at solving metaphysical puzzles. Here I focus on puzzles of occasional identity, wherein distinct individuals at one world or time appear to be identical at another world or time. To solve these puzzles, the usual interpretation rules of counterpart theory must be extended beyond the simple language of quantified modal logic. I present a more comprehensive semantics that allows talking about specific times and worlds, that takes into account the multiplicity and sortal-dependence of counterpart relations, and that does not require names to denote actual or present individuals. In addition, the semantics I defend does not identify ordinary individuals with world-bound or time-bound stages and thereby avoids the most controversial aspect of counterpart theory. Humphrey's counterpart at other worlds or times is none other than Humphrey himself.

1 The paradox of occasional identity

The train from Berlin to Düsseldorf and Cologne passes through a place called Hamm, where it gets divided: the front half continues to Düsseldorf, the rear half to Cologne. Before the division, the two halves compose a single train. (The announcement on the train says that *this train will be divided*, not that *these trains will be separated.*) After the division, two trains seem to be leaving Hamm – one towards Düsseldorf, the other towards Cologne. (Passengers entering between Hamm and Cologne are entering a train to Cologne, and not a train to Düsseldorf.) So there is one train before Hamm, and two trains after Hamm. Yet if you asked whether the train from Berlin ends at Hamm, you would get a negative answer. This is even more obvious if you travel in the opposite direction, say from Cologne to Berlin: the train you enter in Cologne will take you all the way to Berlin, not just to Hamm, where it gets connected with a train from Düsseldorf.

* Thanks to Daniel Korman, Holly Lawford-Smith, Christian Nimtz, Daniel Nolan, the participants of a metaphysical conspiracy in Berlin, and three anonymous referees for helpful feedback.

So one train enters Hamm, two trains leave Hamm, and the original train does not end there. It would seem to follow that the original train is one of the two trains that leave Hamm – the one to Cologne perhaps. But no. The train to Düsseldorf has as much claim to be coming from Berlin as the train to Cologne. Again, in the other direction you can enter a train to Berlin not just in Cologne, but also in Düsseldorf.

This is a paradox of occasional identity. The single train entering Hamm seems to be identical to both trains leaving Hamm. The problem, of course, is that identity is euclidean: if $x = y$ and $x = z$, then $y = z$.

A more familiar, albeit more far-fetched instance of the paradox involves fissioning people. Imagine a duplication machine that splits a human body lengthwise, creates perfect copies of both sides, and combines each half of the original body with a copy of the missing other side. All this happens very fast, so that the result is two fully functional, qualitatively identical copies of the original body. One would think that humans can survive half of their body being instantaneously replaced by an exact copy. Hence a person entering the duplication machine should survive the procedure; for why should it matter to her survival what happens to the removed half? But then the original person would have to be identical to both persons leaving the machine.[1]

Another familiar example is Theseus's ship, which at the end of the story seems to be identical both to the repaired ship and to the ship reconstructed from the old planks. There are also spatial and modal cases, where an object at one place or possible world seems to be identical to multiple things at another place or world. For a spatial example, consider the river Rhine, which extends upstream both to Dissentis and to Splügen, although the river in Dissentis is not identical to the river in Splügen. For a modal example, let x and y be identical twins and consider a world w where the zygote that actually became x and y did not split; w contains a single individual that may seem to be identical to both of the twins in the actual world. For the sake of concreteness, I will focus on temporal cases in this paper, but most of what I say can also be applied to the other dimensions.[2]

In general, a paradox of occasional identity arises whenever the following statements are all true (where t_1 and t_2 are different times, or places or worlds).

(1) At t_1, there is a single object x of a certain kind.
(2) At t_2, there are exactly two objects, x_1 and x_2, of that kind.
(3) x_1 and x_2 have equal claim to be x.

1 As Robbie Williams pointed out to me, the identity of pre-fission and post-fission subjects may also be supported by the normative relations that obtain between them. For example, it is more acceptable to impose future hardships on oneself than on others, and arguably it would be acceptable for the pre-fission person to impose these sorts of hardships on the post-fission persons.

2 [Gallois 1998: ch.1] gives an overview of a wide range of possible paradoxes of occasional identity. See also [Burgess 2010] for a reminder that our topic has practical, political implications.

(4) At t_2, x has not ceased to exist (and is still an object of the relevant kind).

If (1)–(4) contradict the logic of identity, there could not be any paradox of occasional identity. In any alleged example, at least one of (1)–(4) would have to be false. In the case of personal fission, the most popular response is probably to reject (4). Thus [Parfit 1984] takes the paradox to show that the person entering the duplication machine is killed and replaced by two new persons. Alternatively, one might reject (3) and postulate an asymmetry that privileges one of the successors over the other. [Swinburne 2004] suggests that only one of the bodies leaving the duplication machine will carry the original person's immaterial soul. (This may look less plausible for rivers or trains.) [Lewis 1976] rejects (1) and claims that there were two people already before the duplication. One might also reject (2) and say that the apparently two objects at t_2 are really one and the same, or that there are actually three objects at t_2: x_1, x_2 and the original object x.

I have no general objection to these proposals. Rejecting one of (1)–(4) may indeed be the best option in this or that concrete example. Consider an instance of asymmetric teleportation, where a human body on Earth is duplicated on a remote planet, without destroying the original body. It is natural to think that there is then one person on Earth for the whole time, and a second, new person on the other planet. More controversially, I will argue in section 5 that when a lump of clay constitutes a statue, the two are not identical; the fact they are also not identical at certain other times (or worlds) therefore does not give rise to a paradox of occasional identity. Not everything that resembles a paradox of occasional identity is a genuine instance. However, in some cases, including the above examples of the train, the ship, fissioning persons (or amoebae) and rivers, (1)–(4) do all seem true. In the scenario of the train, it does look like (1) there is initially a single train in Berlin, (2) later there are exactly two relevant trains, one in Düsseldorf, one in Cologne, (3) neither of these is privileged to be the unique train from Berlin, and (4) no train (in either direction) ends at Hamm. Theoretical considerations might lead one to reject some of these claims, but I think they capture how many people actually think and talk about the situation.[3]

3 A referee suggests that after Hamm, the train from Berlin persists as a divided object, one part of which is heading towards Cologne, another towards Düsseldorf. This is a natural thought, but it does not show that any of (1)–(4) is false, since the divided object is no longer a train after Hamm. Perhaps the least revisionary way to deny (1)–(4) from this perspective is to reject (1) and claim that there are really three trains on departure in Berlin: the two later trains as well as their fusion, which ceases to be a train at Hamm; one might then explain the plausibility of (1) by suggesting that when a large train has two smaller trains as part, we usually ignore the smaller trains when counting. This is certainly a defensible diagnosis, although it gets less plausible the more the manner in which the train is divided resembles the fissioning of amoebae. I will present a different analysis, based on a counterpart-theoretic interpretation of the relevant statements. I believe it offers a more attractive solution to the puzzle of the train, as well as to other cases of occasional identity and related puzzles discussed in section 3. I do not claim that it is without alternatives.

Instead of rejecting a particular component of (1)–(4), some authors have appealed to indeterminacy (e.g. [Johnston 1989]). The idea is that our concepts or linguistic conventions do not settle what to say about far-fetched fission scenarios, and hence leave open which of (1)–(4) is false. Again, this may well be right for certain cases, but it is not a satisfactory answer in cases where at least three of (1)–(4) seem determinately true. (I would also say that not all examples are especially far-fetched or rare. The train from Berlin to Düsseldorf and Cologne runs once every hour.)

I will explain how (1)–(4) can all be true, without giving up the euclideanness of identity or relying on controversial metaphysical assumptions. The paradox is resolved by paying close attention to the interaction between singular terms and modal operators. My solution is thus in line with the widespread conviction that the puzzle raised by the above examples is in some sense "superficial" or "merely verbal". According to this line of thought, we could completely describe what is going on in the train scenario by talking about the individual carriages, how they are connected to one another at various times, and so on, without ever mentioning entire trains. Nothing puzzling or contradictory would be said on this level. But intuitively, we also would not have left anything out. It is not like there are fundamental *train facts* over and above facts about attached carriages etc. that would still have to be settled once all the lower-level facts are in place. This suggests that the paradox mainly arises in the application of concepts like 'train' or 'same train' to a situation that, in itself, is not paradoxical at all.

But then how do these concepts work? How do the lower-level truths about attached carriages etc. make true statements about trains, or ships, or people? Are we simply confused when we use these terms in a way that appears to support all of (1)–(4)? I will argue that we are not: there is a coherent and natural interpretation of our ordinary usage on which it is neither contradictory nor confused.

Metaphysicians who reject (1)–(4) sometimes add an explanation for why the rejected claims nevertheless appear true. Consider the account of personal fission in [Lewis 1976]. Lewis argues that persons and other material objects are four-dimensional aggregates of instantaneous (or very short-lived) *stages* which are the primary bearers of many properties. Just as a wall that is white here and red over there has a white part here and a red part there, a person who sits at t_1 and stands at t_2 has a sitting (temporal) part at t_1 and a standing part at t_2. The stages that compose a person are related to one another by a certain *unity relation* R, which according to Lewis is largely a matter of psychological continuity and connectedness. Persons are identified with maximal aggregates of stages that all stand in the R-relation to one another. A fission case therefore involves two persons: every post-fission stage is R-related to every pre-fission stage, but the post-fission stages are not all R-related to one another. It follows that each pre-fission stage is part of two different persons – two different, but overlapping, aggregates of R-interrelated stages. This is why Lewis claims that there are two persons already before the fission.

Now this may be a helpful metaphysical description of the scenario, but if our puzzle concerns the application of ordinary terms and concepts, then it is not much of a solution. We would not ordinarily say (or think) that *two* persons entered the duplication machine, that *two* trains left Berlin, or that Theseus owned *two* ships at the beginning of the story. In fact, it would be very inconvenient to speak in the Lewisian manner, for we would never know how many things we face. Standing at a bridge between Berlin and Hamm, we could not tell how many trains just passed unless we know what happens further up and down the tracks. (Among other things, we would have to know whether there will be an accident down the track: if the splitting is called off, what we saw is one train, otherwise two.)

Lewis could insist that he *is* analysing our ordinary notions of trains and ships and persons, and that we are simply mistaken when we think we know how many trains crossed the bridge. What Lewis actually does is more interesting. He offers a rule for interpreting our ordinary talk in such a way that 'a single train crossed the bridge' comes out true as long as all trains that actually crossed the bridge share a single stage at the relevant time. The rule says that in ordinary language, we count objects not "by identity", but "by stage-sharing" – i.e., we count the cells in the partition effected by the stage-sharing relation.[4]

So there are two parts to Lewis's account. One is the four-dimensional description in terms of aggregates and stages. This is what is really, fundamentally, going on. On this level, (1) is rejected. The second part is an interpretation of our ordinary language in the model provided by the fundamental description. Here (1) comes out true.

Unfortunately, the second part of Lewis's account is at best an incomplete sketch. How, for example, do names and definite descriptions work in a case of fission? When a person (or train, or ship) is baptised 'Mary' and later fissions, which of the two persons have been called 'Mary'? Who does the name pick out after the fission? What happens when the name is embedded in operators that shift the time of evaluation? Lewis never answered these questions.

More seriously, Lewis's interpretation rules are quite revisionary. When we think we see a single train on the bridge, or a single amoeba in a dish, we are, according to Lewis, really looking at two trains and possibly thousands of amoebae. Our thoughts (or words) are only true because 'there is a single X' does not really mean that there is a single X. But the goal is not to come up with any old interpretation that renders our ordinary thought and talk true. We would like an interpretation that we can accept as capturing what we really meant. It would be nice to have an account on which 'there is

4 This is Lewis's proposal in [Lewis 1976]; in [Lewis 2002], he instead suggests that we count temporal parts of the relevant objects. The effect is the same. [Robinson 1985] offers further support for these views on everyday counting.

a single X' is true at the pre-fission time because there really is, strictly and literally and fundamentally, just a single X there.

Before I present my own proposal, let me review another proposal that promises to achieve this goal. It is based on the *stage theory* defended in [Sider 1996] and [Sider 2001], which in turn is based on Lewis's *counterpart theory* ([Lewis 1968], [Lewis 1986]).

2 Stages and counterparts

Sider, in [Sider 1996] and [Sider 2001], agrees with Lewis's four-dimensional picture of reality, but disagrees about the identification of ordinary objects in this picture. According to Sider, ordinary objects are the temporally short-lived stages that Lewis regards as mere temporal parts of ordinary objects. When we say 'this train' at the departure time in Berlin, we refer to a momentary stage that does not exist in the past or the future.

This suggests that Sider rejects condition (4) in our paradox: the object x that exists at t_1 does not exist any more at t_2. The train that leaves Berlin never leaves Hamm; indeed, it disappears immediately after t_1. Since this fits our ordinary thought and talk even less than Lewis's proposal, Sider, like Lewis, offers conciliatory rules for interpreting ordinary language into his stage-theoretic metaphysics.

Consider the train stage x at time t_1. x does not extend temporally beyond t_1. Nevertheless, according to Sider, 'at some time, x arrives at Hamm' is true. This is because 'at some time, x is F' is true iff x has a *temporal counterpart* that is F. The temporal counterpart relation is what we previously met as the unity relation. For trains, it is probably not a matter of psychological continuity and connectedness, and I will not attempt an informative analysis here. (I will assume, however, that unity relations are generally reflexive and symmetric.) It is clear that the train stage x should count as unity-related to a later stage in Hamm. So x has a temporal counterpart at Hamm. Hence we can truly say that the train that leaves Berlin will at some point arrive at Hamm.

This rule for interpreting statements of the form 'at some time, x is F' is modeled on Lewis's counterpart-theoretic interpretation of 'possibly, x is F'. According to Lewis, ordinary objects do not extend across different possible worlds. We have temporal parts at other times, but we do not have "modal parts" at other worlds, nor do we somehow exist wholly and identically at other worlds, perhaps in the way Moscow is wholly and identically both in Russia and in Europe. Still, Lewis does not conclude that we have all our actual properties essentially. Instead he suggests that 'possibly, x is F' is true as long as some (modal) counterpart of x at some possible world is F.

On this account, we have to distinguish two senses in which an object can have a property relative to a time (or world, or place). In the fundamental sense, property instantiation is a private affair between a stage and a property. No time or place or world is involved. To say that x is F at t simply means that x is located (wholly and entirely) at t, and that it is F. In the other, derivative sense, one can truly say that x is F at t even if x is not located at t, as long as x has a counterpart at t which is F (in the fundamental, non-relative sense). In the fundamental sense, the train that leaves Berlin does not exist at t_2. In the derivative sense, it does. The ordinary sense is clearly the derivative sense.

How does the stage-theoretic account compare to Lewis's account in terms of aggregates? That there is only one train on the bridge now straightforwardly comes out true, but lots of other things we would normally consider true can be rescued only by forceful re-interpretation: that the train is several years old, or that there has been only one train on this platform during the last 10 minutes. In the end, the stage-theoretic interpretation rules are at least as revisionary as the Lewisian rules.

Again, it is a bit of an exaggeration to speak of 'interpretation rules' here, as nobody has yet attempted a counterpart-theoretic interpretation for a significant fragment of English. [Lewis 1968] gives rules for interpreting the standard language of quantified modal logic into his counterpart-theoretic (modal) metaphysics, but the language of quantified modal logic is a very impoverished language. It does not allow formalising claims like (1)–(4). At a minimum, we here need operators like '*at* t_2' that consider not only whether something is true at *all* times or at *some* times (or worlds), but whether something is true at a particular time (or world) t_2. Modal logics that include operators like 'at t_2' are known as *hybrid logics*.

In the remainder of this section, I will sketch a counterpart-theoretic semantics for (quantified) hybrid logic on which (1)–(4) can all be true, without abandoning the euclideanness of identity. I offer this as a gift to the stage theorist, but the offer is not entirely altruistic. As will become clear in the next section, essentially the same semantics will figure in my own proposal.

As usual in the semantics for modal languages, sentences are interpreted at a particular point, the "utterance time" α. All names and variables denote stages (which may or may not be located at α). Predicates express relations between stages. Operators like 'at some time' or '*at* t' shift the time of evaluation: '*at* t, Fx' is true (at the utterance time α) iff 'Fx' is true relative to the time denoted by 't'. But when we evaluate 'Fx' relative to t, we do not use the original interpretation of 'x'. Rather, when the time of evaluation is shifted from α to another time t, the reference of all singular terms is shifted as well: if 'x' originally denotes a certain stage x located entirely at α (say), then relative to t, the term denotes a different stage x' located at t – namely x's counterpart at t. Similarly, 'at some time, Fx' is true (at α) iff 'Fx' is true relative to some time t, i.e. iff there is a time t such that x's counterpart at t has the property expressed by 'F'.[5]

5 For simplicity, I do not distinguish between names and individual variables. Following [Lewis 1968] and [Stalnaker 1987], [Stalnaker 1994], one might instead restrict the counterpart-theoretic treatment

All this is straightforward as long as x has a unique counterpart at t. What if there are several counterparts, or none? The case of zero counterparts is not directly relevant to our puzzle, so I will set it aside for the moment. If x has several counterparts at t, then shifting the reference of 'x' from x to its counterparts at t leaves the term ambiguous, in a sense: it now denotes several things at once. To motivate the following decisions, let us have a quick look at ordinary ambiguity.[6] (I will return to this analogy in section 4.)

There are two Londons, one in the UK and one in Canada. So 'London is in Canada' is true on one interpretation of 'London' and false on another. It might be best to leave it at that, but suppose we want to assign truth-values even to ambiguous sentences. How could we do that? We might say that a sentence (or at least, a logically atomic sentence) is true iff it is true on every disambiguation. 'London is in Canada' and 'London is in the UK' would then come out untrue. Alternatively, we could say that these sentences are true as long as they are true on *some* disambiguation. This 'subvaluationist' reading, on which both sentences are true, arguably better fits our usage.

A second question is whether disambiguations can be *mixed*: is there a disambiguation of 'we traveled from London to London' on which the first 'London' refers to London, UK, and the second to London, Ontario? Ordinary usage seems to allow for this. It may not be very helpful to say 'we traveled from London to London', but in a suitable context, this may well be considered a somewhat curious truth. (When asked what state New York belongs to, 'New York is in New York' may even be true and helpful.)

The same options arise in our semantics for hybrid logic with multiple counterparts, and I suggest we make the same choice. Thus if 'x' originally denotes a stage with several counterparts at t, then '$at\ t, Fx$' is true if *at least one* of those counterparts satisfies 'F'. Different counterparts may be assigned to different occurrences of a term: '$at\ t, Rxx$' is true if some t-counterpart of x is R-related to some t-counterpart of x.[7]

So at the time t_1 when the train departs from Berlin, you could truly say 'in five hours, this train will be in Cologne'. The demonstrative 'this train' denotes a present train stage x; 'in five hours' shifts the denotation to the relevant counterparts of x, of which there are two. Your utterance is true because one of those counterparts is in Cologne. You

to individual variables, using either lambda-abstraction or a Russellian analysis to formalise *de re* modal statements involving names. The idea that intensional operators can be understood as shifting the reference of terms is somewhat hidden in [Lewis 1968] and [Stalnaker 1987]. I think bringing it to the surface makes the formal semantics simpler and more intuitive.

6 See [Lewis 1982], [Priest 1995], [Ripley 2013] for a defense of the following remarks. There are, of course, alternative treatments of ambiguity, see e.g. [Frost-Arnold 2008].

7 The translation rules of [Lewis 1968] effectively require truth on all assignments of counterparts for box formulas and truth on some assignments for diamond formulas. The existential and universal readings are often mentioned as possible interpretations for the 'actually' operator; see e.g. [Hazen 1979]. Lewis is not clear on the choice between mixed and uniform assignments; see [Woollaston 1994] for a brief discussion. Mixed assignments are effectively used in [Forbes 1982], [Ramachandran 1989] and follow-up work by these authors, uniform assignments are used in [Sider 2008] and [Russell 2013].

could also have truly said, 'in five hours, this train will be in Düsseldorf'.

There is a third question, about which I am less sure: how do ambiguous sentences interact with negation and other logical operators? If 'London is in Canada' and 'London is in the UK' are both true, what about 'it is not the case that London is in Canada'? One could say that this is the negation of something true and hence untrue. But one could also classify it as true on the grounds that truth on some disambiguation is always sufficient for truth. In the example of the train, what shall we say about 'in five hours, it is not the case that this train will be in Cologne', or 'it is not the case that in five hours, this train will be in Cologne'? Counting them both as true would lead to a (quantified hybrid) version of Priest's paraconsistent Logic of Paradox, LP (see e.g. [Priest 2006]). I have decided, somewhat arbitrarily, to treat them as both false. In general, the boolean connectives retain their standard interpretation, both inside and outside the scope of intensional operators. The multiplicity of meanings sometimes created by such operators is only unpacked in the semantics of atomic predications.

We can then explain how (1)–(4) may all be true. Here they are again.

(1) At t_1, there is a single object x of a certain kind.
(2) At t_2, there are exactly two objects, x_1 and x_2, of that kind.
(3) x_1 and x_2 have equal claim to be x.
(4) At t_2, x has not ceased to exist (and is still an object of the relevant kind).

The apparent conflict with the logic of identity arises as follows. Focus on t_2. By (2) and (4), we then have two objects x_1 and x_2, while the original object x still exists. Since x_1 and x_2 have equal claim to be x, it cannot be that x is identical to x_1 unless x is also identical to x_2, and conversely. So

(5) $$x = x_1 \leftrightarrow x = x_2.$$

By (2), x_1 and x_2 are the only objects of the relevant kind. Together with (4), this means that x is either x_1 or x_2 or both:

(6) $$x = x_1 \vee x = x_2.$$

By elementary propositional logic, (5) and (6) entail that $x = x_1 \wedge x = x_2$. But identity is euclidean, i.e.

(7) $$x = x_1 \wedge x = x_2 \supset x_1 = x_2.$$

So by Modus Ponens, $x_1 = x_2$. And now we have a contradiction with (2), which says that

(8) $$x_1 \neq x_2.$$

Here I have conveniently dropped the prefix 'at t_2'. But this is important to the counterpart-theoretic solution. If we put it in, we get

(5*) $\quad at\ t_2, (x = x_1 \leftrightarrow x = x_2)$.

(6*) $\quad at\ t_2, (x = x_1 \vee x = x_2)$.

(7*) $\quad at\ t_2, (x = x_1 \wedge x = x_2 \supset x_1 = x_2)$.

(8*) $\quad at\ t_2, x_1 \neq x_2$.

However, while (7) may be a logical truth, (7*) can be false on the interpretation just outlined. Assume the stage denoted by 'x' has two counterparts at t_2, denoted respectively by 'x_1' and 'x_2'. In the scope of 'at t_2', each occurrence of 'x' then denotes x_1 on one assignment of counterparts and x_2 on another. ('x_1' and 'x_2' keep their original reference, since the two stages are their own sole counterparts at t_2.) Thus '$x = x_1$' and '$x = x_2$' are both true in the scope of 'at t_2', while '$x_1 = x_2$' is false. The inference to '$x_1 = x_2$' involves something like a fallacy of equivocation. By analogy, the fact that London is the 15th largest city in Canada and that London is the capital of the UK does not imply that the 15th largest city in Canada is the capital of the UK.

On the paraconsistent alternative, (5*)–(8*) are all true. Moreover, (5*) and (6*) do entail that $at\ t_2, (x = x_1 \wedge x = x_2)$. But from the fact that $at\ t_2, (x = x_1 \wedge x = x_2)$ and that $at\ t_2, (x = x_1 \wedge x = x_2 \supset x_1 = x_2)$, one cannot infer that $at\ t_2, x_1 = x_2$, because modus ponens is invalid on this interpretation: A may be true on one disambiguation, and $A \supset B$ on another, while B is false on any disambiguation.[8]

I said that I would like to offer my semantics as a gift to stage theorists like Sider, but I suspect Sider will not accept it. The reason is that my account violates certain principles of traditional hybrid logic, which Sider would probably want to preserve (see [Sider 2008]). I will address worries about non-standard logics in section 4.

3 Counterparts of persisting objects

Equipped with something like the counterpart-theoretic semantics just outlined, stage theory offers an attractive escape from the paradox of occasional identity. The apparent inconsistency in statements like (1)–(4) is explained as the effect of a harmless semantic phenomenon akin to ambiguity. On the other hand, we have seen that the stage theoretic

8 Other ways of dealing with multiple denotation would also provide a solution to the paradox. For example, suppose you dislike mixed assignments and think that truth should require truth on *all* assignments. (5*) is then false, but you might argue that it does not follow from (3), the claim that x_1 and x_2 have equal claim to be x: what this rules out, you might argue, is merely that $at\ t_2, x = x_1 \wedge x \neq x_2$ or that $at\ t_2, x = x_2 \wedge x \neq x_1$, and these do both come out false. In general, that x_1 and x_2 have equal claim to be x is validated in one way or another by any semantics that treats x_1 and x_2 symmetrically.

solution involves a rather revisionary interpretation of ordinary thought and talk. It also presupposes controversial metaphysical doctrines. Many philosophers think that persons and trains persist through time without dividing into temporal parts; these philosophers deny the existence of person stages or train stages. Even if you are happy with stages, you may agree that it is a contingent matter that material objects are composed of stages, and that versions of the paradox could still arise in worlds without stages. The stage theoretic solution then will not be a general solution. Remember also that there are modal versions of the paradox. If possible worlds are maximal propositions and a proposition may directly involve objects like Hubert Humphrey, then you may not want to analyse Humphrey's winning at some world w in terms of world-bound individuals and counterparts.

Can we keep the counterpart-theoretic solution to the paradox without taking on board the whole counterpart-theoretic metaphysics and semantics? We can. What solves the paradox is the idea that singular terms may undergo reference shift in the scope of intensional operators. This does not require that the referents are stages.

So here is my proposal. Terms for trains, ships and persons denote temporally extended objects, which may or may not divide into temporal parts. However, when we evaluate a sentence of the form 'at t, x is F', what matters is not whether the object denoted by 'x' is F relative to t. Rather, what matters is whether the t-counterparts of this object are F at t. Normally this makes no difference, because x will be its own sole counterpart at any time at which it exists, so we can ignore the counterpart-theoretic complication. But in a case of fission, for example, a single person x may have two counterparts at a future time t, and then the complication matters.

To render all this more precise, let us return to the traditional four-dimensional picture, where ordinary objects are taken to be aggregates of stages. We saw that Lewis identified persons with maximal aggregates of stages all of which are unity-related to one another. I prefer an alternative proposal due to [Perry 1972] on which a person is a stage s together with all stages standing in the unity relation to s. Unlike Perry, however, I would like to exclude other stages at the time of s. So for any time t, define a *person at t* to be an aggregate of some person stage s at t together with all stages at non-t times that stand in the relation of personal unity to s. (Similarly for trains, ships, etc.) If x is a person at some time t and s is its t-stage, we say that s *determines* x.[9]

9 I exclude other stages at the time of s mainly to account for time-travel scenarios – see below. The more substantial disagreement between Perry and me is that he does not combine his metaphysics with a counterpart-theoretic semantics. Perry suggests that as a sentence operator, 'at t' shifts the referent of singular terms x to the unique object determined at t by a stage unity-related to the present stage associated with x. In a statement of the form 'x is F at t', however, 'at t' is treated as a predicate modifier, which is subject to different rules; the statement is true iff at least one t-stage of the object picked out by 'x' satisfies 'F'. [Moyer 2008] defends a simplified version of Perry's account on which 'at t' always works in this latter way. The Perry-Moyer account and mine largely agree on

In simple cases, where no stage is unity-related to multiple stages at any single time, this account gives the same verdict as Lewis's. On the other hand, consider a case of personal fission.[10] Every pre-fission stage s is unity-related to every other pre-fission stage as well as every post-fission stage. So there is only one person at the time of s, namely the Y-shaped aggregate consisting of s together with all its ancestors and descendants. On the other hand, there are two persons at t_2, after the fission, corresponding to the two branches (including the stem) of the Y. The whole Y also exists at this point, but it is a fusion of two persons at t_2, rather than a single person at t_2.

Now we need to link the technical notion of a *person at t* to the ordinary notion of a person. We do not want to say that the person entering the duplication machine will be a fusion of two persons later. You might also want to say that personhood is generally not the kind of property things can gain or lose. That is, if x is a person at t_1 and still exists at t_2, then x should be a person at t_2. This is where the counterpart-theoretic semantics comes in. Suppose at t_1, the name 'x' is introduced for the Y-shaped object that is a person at t_1, in the relational sense of 'person' just defined. At this point, one can then truly say that x is a person, but also that x will be a person at t_2. That's because in the scope of '*at* t_2', the reference of 'x' shifts to the two counterparts of the Y-shaped object, which are the two branches of the Y. These counterparts are persons at t_2. So in the scope of '*at* t_2', the term 'x' is referentially indeterminate between two things both of which count as persons relative to t_2.

The counterpart relation in use here can be defined in terms of unity: an individual y at t_2 is a counterpart of x at t_1 iff x is determined by a stage s_x at t_1, y is determined by a stage s_y at t_2, and s_y is unity-related to s_x. Note that counterparthood has become a doubly tensed relation involving two individuals and two times. The basic idea is simple: starting with a persisting individual x at t_1, you find the t_2-counterparts by collecting all t_2-stages unity-related to the t_1-stage of x, and expanding those stages by everything that is unity-related to them. In the fission case, the Y-shaped object that is a person at t_1, before the fission, is its own sole counterpart at any other pre-fission time. Relative

what is true in a case of fission, but they differ in a number of important respects. For one thing, I do not assume that singular terms are associated with stages, and my account is not limited to predicates that express properties of stages. In particular, I do not interpret identity as identity of stages. If 'Goliath' denotes a certain statue and 'Slice' its stage at t (assuming there is such a stage, on which my account is officially neutral), then 'at t, Goliath = Slice' is false on my account, but true on the Perry-Moyer account. Statues, on my view, are not identical to temporally unextended stages. Moreover, unlike the Perry-Moyer account, my solution to the paradox of occasional identity also carries over to Chisholm's paradox and other related puzzles.

10 In what follows, I assume that fissioning people give rise to a paradox of occasional identity. As mentioned on p.3, I am not committed to this particular example. Perhaps the unity relation for persons includes a "non-branching" condition, in which case the present account agrees with Parfit that persons cannot survive episodes of fission. However, we do not *have* to postulate a non-branching condition for objects of every sort merely to remain consistent.

to a time t_2 after the fission, however, it is no longer its own counterpart, because it is not determined by any t_2-stage. The t_2-stages unity-related to the t_1-stage instead determine the two branches of the Y, which are therefore the t_2-counterparts of the person at t_1. Ordinary, non-fissioning objects are their own sole counterparts at all times. Here counterparthood reduces to identity.

Having defined a counterpart relation between temporally extended objects, we can essentially take over the rest of the stage-theoretic semantics, and with it the solution to the paradox of occasional identity. The only complication is to fill in the time indices for the counterpart relation. For the moment, let us say that if an operator '*at* t_2' shifts the point of evaluation from t_1 to t_2, then the reference of any embedded singular term shifts to the counterpart at t_2 of the old referent at t_1. This has the unwanted consequence that the new referent must be determined by some stage at t_2, and the old one by some stage at t_1, which effectively rules out names for non-present objects. A solution to this problem will emerge in section 5, so the corrected rule will not be given until section 6.

Before descending into these details I want to highlight the main features of my proposal. In contrast to stage theory, the present account is not based on a revisionary identification of ordinary objects in fundamental reality. We no longer have to say that 'the Earth' denotes an object that (strictly speaking) exists only at this very moment. Planets, persons and trains are identified with temporally extended objects. More importantly perhaps, what we normally think of as properties of temporally extended objects – being a philosopher, believing in unrestricted composition, being 50 years old – really are properties of extended objects. We no longer have to explain in what sense a momentary person stage can be a 50 year old philosopher, or can be the subject of beliefs and desires.

The interpretation of modal and temporal operators also becomes more intuitive. If the present Humphrey stage is unity-related to a single stage at some time t at which Humphrey is winning an election, then 'Humphrey' denotes the same person inside and outside the scope of 'at t'; 'Humphrey wins at t' is true because at the relevant time, *this very person here* has the property of winning – just as [Kripke 1980: 45] and many others intuit. It does not even matter if Humphrey is subject to fission and fusion at other times. As long as the present Humphrey has only one counterpart at t, that counterpart will be Humphrey himself. The counterpart-theoretic machinery only springs into action when we directly deal with puzzle cases where, for example, an episode of fission has left behind two Humphreys at the relevant time t.

Even in such puzzle cases, the basic ideas behind the proposed interpretation are quite natural. Let us go back to the more mundane example of the train. If the train x will have split into two trains by t_2, and we try to evaluate the claim that x is in Cologne at t_2, it really does seem as if 'x' has acquired something like multiple denotations, or candidate denotations, relative to t_2. This is why it is tempting to "disambiguate" and introduce new terms for the two candidates in the scope of the relevant operator.

Unlike some other attempts to reconcile (1)–(4), notably [Myro 1985] and [Gallois 1998], my proposal does not tamper with identity. '=' denotes the familiar, untensed, two-place relation that figures in '$\sqrt{9} = 3$'. If '*at* $t_1, x = y$', and '*at* $t_2, x \neq y$' are both true, this is not because identity has become a three-place relation linking individuals and a time. It is because the operators '*at* t_1' and '*at* t_2' shift the reference of 'x' and 'y'. Coreference relative to t_1 therefore does not guarantee coreference relative to t_2.

So far, I have assumed a four-dimensionalist picture of stages and aggregates. It should be clear that much of this is dispensable.[11] What matters is only that we have persisting objects that stand in counterpart relations to one another. In an endurantist framework, where ordinary objects do not divide into temporal parts, counterparthood cannot be defined in terms of unity between stages. The unity relation must now be understood as a relation between persisting objects at different times. For example, an endurantist might suggest that x at t_1 *is the same person as* y at t_2 iff there is a suitable chain of psychological and biological continuity leading from x's state at t_1 to y's state at t_2. As before, I do not assume that one can give an informative analysis of personal unity; it is enough that we can somehow understand what it means to say that x at t_1 is the same person as y at t_2, without reducing it to a relation between stages. The counterpart relation, in this framework, is then simply the unity relation. Our counterpart-theoretic semantics will say that when an operator shifts the time of evaluation from t_1 to t_2, the reference of singular terms shifts to whatever stands at t_2 in the unity relation to the previous referents at t_1. Endurantists can therefore agree that the pre-fission person at t_1 is unity-related to both persons at t_2.

To avoid terminological confusion, I generally reserve the term 'unity relation' for the four-dimensionalist unity relation between stages (except in the preceding paragraph). Hence the endurantist's doubly tensed surrogate for the unity relation is a counterpart relation, not a unity relation. For example, when I said that I assume the unity relation to be symmetrical, this does not apply to the endurantist unity relation, i.e. the counterpart relation.

I have mentioned two respects in which the present proposal appears superior to the stage-theoretic alternative: it offers a more straightforward, less contrived interpretation of ordinary language, and it avoids commitment to controversial metaphysical assumptions such as the existence of stages. There are further advantages, of which I want to briefly mention three.

First, in contrast to both stage theory and Lewis's aggregate theory, we immediately

11 The term 'four-dimensionalism' is used for positions of different metaphysical strength (see [Sider 2001: xiiif.]). While my account does not presuppose the view that material objects are aggregates of temporal parts, it does presuppose – at least on the surface – that the future is equally real and 'given' as the past or the present. It might be possible to explain away this appearance, perhaps in the way [Stalnaker 2003] suggests that possible-worlds semantics does not presuppose the reality of merely possible worlds and individuals. But I will not pursue this question here.

get the right answer to many counting questions. *One* person enters the duplication machine at t_1, *two* persons leave it at t_2; *one* person was in the preparation room in the ten minutes leading up to the duplication; *one* amoeba was in the petri dish for the last hour. Stage theory and Lewis's aggregate theory need elaborate epicycles to deliver these verdicts. On the present account, they automatically come out right.[12]

Compared to stage theory, the present account also has fewer problems with names for non-present objects – once we have made room for them in section 6. Since Albert Einstein, for example, has no present stage, it is hard to see which of all the past Einstein stages is supposed to be the referent of 'Einstein'. On the present account, 'Einstein' can simply denote the whole persisting person that existed from 1879 to 1955.

Another advantage is that our solution to the paradox of occasional identity nicely generalises to a number of related puzzles such as the Methusaleh puzzle discussed in [Lewis 1976] and its modal counterpart, "Chisholm's paradox" (from [Chisholm 1967]). Consider a river which gradually changes its course through the millennia, occasionally spawning new branches and merging with other rivers. We might want to say that the river that was there a million years ago is not identical to the completely different river today, although there is no day on which the original river ceased to exist and a new

12 Things get tricky when we try to count across an interval that involves fission or fusion. Lewis [1976: 73] asks how many persons there are in an interval during which x fissions into x_1 and x_2, and intuits that the answer should be 'two'. One difficulty here is that the Y-shaped object x ceases to be a person at the time of the fission, at which point its two branches x_1 and x_2 begin to be persons. Another complication is that x is composed of x_1 and x_2, and the standards for counting overlapping objects are murky. (If you own a building that is made of two smaller buildings, how many buildings do you own: one? two? three?) *Pace* Lewis, I do not think that there is an obviously correct answer to his question. Still, let us see what our account predicts.

Consider first a slightly simpler case. Suppose x is in room 101 before the fission, and afterwards x_1 is in 101 and x_2 in 102. How many persons are there in room 101 during the whole episode? One might think the present account predicts the answer to be 'two', because $x \neq x_1$. However, one might just as well say that the predicted answer is 'one', on the grounds that '$x = x_1$' is true relative to every time in the interval. More precisely, the following statement is true for all t_1 and t_2 in the interval: 'at t_1, there is exactly one person x in room 101 such that at t_2, every person in room 101 is identical to x.' Arguably, this is sufficient for it to be true that there is exactly one person in the room throughout the interval.

Now suppose x_2 is also in room 101 after the fission. Assuming the details of the present account are filled in sensibly (as for example in the appendix), it then comes out true that at any pre-fission time, there is a single person in the room that is identical to every person in the room at any other time, while at post-fission times, there are two persons in the room such that any person in the room at other times is identical to one of them. The former would seem to entail that the total number of persons is one; the latter that it is two. Perhaps one should therefore say that the answer to Lewis's question is predicted to be indeterminate between 'one' and 'two'. One might also include 'three' as a legitimate answer by the reasoning that this is the total number of objects (including overlapping objects) that are persons at some time during the interval.

river came into being. The river stage at any intermediate time is unity-related to many stages in the future and in the past. On the present account, it follows that on each day after the formation of the original river, there was a unique river which was identical to the river that existed the previous day as well as the river that existed the following day, although the river that existed in the beginning is not the river that exists today.

We can also handle time travel cases. Suppose a time-traveler x travels back to time t and visits her younger self. We can then say that in the scope of '*at* t', 'x' multiply refers to both persons determined by the time traveler's two stages at t. Here the difference to Perry comes into play: according to [Perry 1972], there would be a single person at t, comprising both stages. The same is true for Lewis, because the two t-stages are part of one and the same maximal unity-interrelated aggregate. This makes it hard to interpret the kinds of things people say about time-travel cases: that the time-traveler *arrived at* t, *went to her old house*, *opened the door to her bedroom*, etc. On the account I have defended, these are handled much like in a scenario where the hero has fissioned into two people at t, one of which comes visiting the other.

So much for advantages. On the flip side, I suspect some will feel uneasy about the somewhat revisionary logic generated by my counterpart-theoretic semantics. I will try to defuse this worry in the next section. A more serious problem, in my view, is that the present semantics is still inadequate in some crucial respects. Apart from the problem with names for non-present objects, it does not take into account the multiplicity of counterpart relations. I have mentioned in passing that the unity relation for persons may not be the same as that for trains. Different unity relations give rise to different counterpart relations, and such differences play an important role, for example in Gibbard's [1975] puzzle of Lumpl and Goliath. These issues will be the topic of sections 5 and 6.

4 Occasional identity and non-standard logics

A standard rule of hybrid logic is the principle of *at-generalisation*, which says that whenever a formula A is logically true, then so is *at* t, A. In section 3, we saw that this is invalid on the semantics I proposed: while

(7) $\quad x = x_1 \wedge x = x_2 \supset x_1 = x_2$

may be logically true,

(7*) $\quad at\ t_2, (x = x_1 \wedge x = x_2 \supset x_1 = x_2)$

is false if x_1 and x_2 are distinct counterparts of x at t_2.

I mentioned some alternative interpretations, based on different treatments of multiply referring terms. The paraconsistent variation, for example, validates at-generalisation, but invalidates modus ponens. Other natural options validate both modus ponens and at-generalisation, but fail to validate either the *hybrid distribution* axiom

$$at\ t, (A \supset B) \wedge at\ t, A \supset at\ t, B$$

or *self-duality*

$$at\ t, A \leftrightarrow \neg at\ t, \neg A.$$

What shall we make of this logical deviance? In recent discussions of counterpart theory, it is sometimes considered a fatal flaw. Fara and Williamson [2005], for example, argue that by invalidating principles analogous to self-duality or distribution in the logic of *actually*, counterpart theory allows "contradictions" to be true, and is therefore unacceptable. Proponents of counterpart theory such as Ramachandran [2008], Sider [2008] and Russell [2013] have consequently gone to great lengths looking for counterpart-theoretic interpretations that avoid the logical deviance. (I will briefly return to the logic of *actually* in the appendix.)

By contrast, I think the relaxed logic generated by the present semantics should be considered a *virtue*, as it mirrors what we find in ordinary thought and talk, and solves the paradox of occasional identity. In standard quantified hybrid logic, any sensible formalisation of (1)–(4) is inconsistent, so at least one of the four claims would always have to be rejected.

Recall that our problem essentially concerns ordinary thought and talk. I fully agree that we could say everything that is worth saying about the fissioning train, for example, in a regimented language that obeys all the standard principles. It may even be advisable to use some such regimentation of ordinary language for the purpose of systematic metaphysics or the construction of railway schedules. But this does not change the fact that by ordinary standards, (1)–(4) can all be true.

More importantly, the present account offers a simple explanation for the logical peculiarities of "common-sense ontology": when intensional operators shift the point of evaluation, singular terms can acquire multiple denotations if several candidates at the shifted point equally qualify as the new denotation. Standard logical systems do not allow for multiply denoting terms, and it is no surprise that various standard principles break down when such terms are allowed. At first glance, the invalidity of *at*-generalisation may seem objectionable: if A is logically true, then surely A ought to be true at any given time t! But what if the sentence A changes its semantic properties when embedded under '$at\ t$'? On the interpretation I proposed, the embedding can turn a sentence without multiply denoting terms into a sentence with multiply denoting terms, which is subject to different logical constraints. This semantic explanation is crucial to my defense of occasional identity. Here it contrasts with the accounts of Gallois [1998] and Myro [1985], who also reject various parts of standard modal logic, but without offering any defusing semantic explanation. We would have to take it as a brute fact that those principles fail.

Even staunch proponents of classical logic should admit that classical principles may fail in languages with multiply denoting terms. [Lewis 1982], for example, defends LP as the logic of ambiguity, and Lewis is not generally known as a card-carrying dialetheist. According to Lewis, the classical contradiction 'London is in Canada and London is in the UK' is true – not because reality is in some deep sense contradictory, but because 'London' has two denotations, each of which renders one part of the sentence true.

A case of multiple counterparts is in many ways like a case of ambiguity, but the analogy is not perfect. In the face of ambiguity, classical logic can be restored by disambiguating the relevant terms: London_1 is in Canada, London_2 in the UK. In practice, disambiguation is often achieved by conversational context and speaker intentions. When someone says 'London is in Canada', it is usually clear which London is meant. But not always. If someone who has never heard of either London watches a news report about London, Ontario, and then reads an article about London, UK, without realising that the two cities are distinct, their use of 'London' may well be ambiguous between the two Londons, and neither context nor speaker intention will resolve the ambiguity. Arguably, 'jade' and 'mass' were ambiguous in everyone's usage until scientific investigation revealed that the supposed referent is actually two, rather different, things (see [Field 1973]). Multiplicity of counterparts is more like those latter examples in that it is rarely resolved by context or speaker intentions. To "disambiguate" a sentence like 'this train will be in Cologne', you would have to replace 'train' by an artificial sortal like 'train-qua-turning-South', associated with a different unity relation.

More interestingly, the type of multiple denotation postulated in counterpart semantics is not due to indeterminacy of linguistic conventions or intentions. 'This train', uttered in Berlin (outside the scope of intensional operators), is not ambiguous between 'this train-qua-turning-South' and 'this train-qua-turning-North'. It unambiguously denotes the Y-shaped object, while the other two terms pick out its branches.

Given these disanalogies, it is perfectly possible that multiple counterparthood should receive a different treatment than ordinary ambiguity. If you prefer, say, a paraconsistent account of ambiguity and a supervaluationist account of multiple counterparts, I have not said much to dissuade you. What matters for the present point is that both phenomena involve some kind of multiple denotation and thereby give rise to non-standard logics.[13]

13 Another phenomenon that is in some ways *like* ambiguity is vagueness, where multiplicity of reference shows up as multiple ways of rendering vague expressions precise. It is not a coincidence that the only major account of vagueness that retains classical logic, epistemicism, denies that vagueness involves any sort of multiple denotation.

5 Statues, lumps, and multiple unity relations

Recall the story of Lumpl and Goliath from [Gibbard 1975]. Transformed to the temporal dimension, it describes a piece of clay called Lumpl which one day gets formed into the statue Goliath. Afterwards, Lumpl and Goliath occupy the very same space on a shelf. Some philosophers conclude that Lumpl has become identical to Goliath, for different material objects should not be at the same place at the same time. On the other hand, Lumpl is older than Goliath, since it already existed before it was shaped into the statue. And if x is older than y, then it is hard to see how x and y could be identical.

Within a four-dimensional metaphysics, identifying Lumpl and Goliath goes most naturally with stage theory, while aggregate theories tend to treat them as two. On the aggregate view, the present stage of Lumpl is identical to the present stage of Goliath, which explains how the two can be at the same place at the same time. Lumpl and Goliath are not identical, but also not distinct, mereologically speaking: Goliath is a temporal part of Lumpl. In stage theory, on the other hand, the identity of present stages suggests that Lumpl and Goliath really are a single object. The fact that Lumpl is older than Goliath then has to be explained by appealing to different counterpart relations associated with the two names. The name 'Lumpl', on this view, goes with a counterpart relation that emphasises continuity of matter (in some sense), while the counterpart relation associated with 'Goliath' puts more weight on continuity of (say) shape. If we then analyse 'x is older than y' as 'x has earlier temporal counterparts than y', it follows that Lumpl is older than Goliath, despite the fact that they are identical.

My own account sides with the aggregate view. Assuming four-dimensionalism, the present Lumpl-and-Goliath stage is linked to the early stages of Lumpl by the unity relation for pieces of clay, but not by the unity relation for statues. So the *lump* determined by the present stage is not identical to the *statue* determined by that stage. Since 'Lumpl' denotes the lump and 'Goliath' the statue, the two are not identical, although they share their present stage.

The case of Lumpl and Goliath is therefore not a case of occasional identity. In a genuine case of occasional identity, one and the same unity relation relates a stage at one time to multiple stages at another time. In the example of the train, the train's Berlin stage is train-united both with a later stage in Cologne and with one in Düsseldorf; in the case of personal fission, the person stage entering the duplication machine is person-united with both stages emerging from the machine. There is *one train* and *one person* at the initial time t_1, and several at t_2. Not so in the case of Lumpl and Goliath. To be sure, we have *one statue* and *one piece of clay*. But this does not mean that the statue is identical to the piece of clay.[14]

14 Admittedly, we might want to say that there is only *one material object* on the shelf. However, this would seem to suggest not only that Goliath is identical to Lumpl, but also that Goliath's left half is

In recent discussions, Lumpl and Goliath often figure as the standard example of occasional identity. This is unfortunate, not only because the example is not one of occasional identity at all. It also makes the puzzle appear much easier than it is. There are plenty of good solutions to *this* puzzle: appealing to multiple counterpart relations, Carnapian intensions (as in [Gibbard 1975]), or rejecting the identity in favour of stage-sharing or "constitution". None of this looks very promising when it comes to fissioning trains or people or amoebae.

Nevertheless, the case of Lumpl and Goliath is instructive, because it draws attention to the fact that there are different, and sometimes competing, unity relations. These are often associated with specific sortals: 'train', 'statue', 'person'. But there is no good reason to think that the supply of sortal nouns in English exhausts the unity relations. Perhaps when we say that Fred believes that Hesperus is not Phosphorus, 'Hesperus' and 'Phosphorus' are associated with different modal unity relations. For an object in one of Fred's doxastically possible worlds to count as Hesperus it must play the Hesperus role; for it to count as Phosphorus it must play the Phosphorus role. These roles do not correspond to different sortals in English. When dealing with cases of occasional identity, it seems that we can also introduce new sortals, speaking of the ship-qua-assembly-of-those-planks, or the train-qua-turning-South, as I did in the previous section. These pick out specific branches of the Y-shaped object even before the fission.

Since counterparthood can be defined in terms of unity, the multiplicity of unity relations gives rise to a multiplicity of counterpart relations. Often the relevant counterpart relation can be read off from the denoted objects. If something consists of all stages lump-united with a present stage, but not of all stages statue-united with that stage, then it is a lump and not a statue, and so the relevant counterpart relation should be the relation for lumps and not the one for statues. However, this does not work if an object's stages happen to be united by several unity relations. (More precisely, if the object is determined by a given stage along several unity relations.) For example, the train that arrives in Cologne at t_2 consists of the very same stages as the train-qua-turning-South that arrives in

identical to his right half: both are material objects, and both are on the shelf. When we say that the number of material objects is one, we are somehow ignoring the two halves. Perhaps we count in a way that ignores proper parts of ordinary material objects. But then Goliath, being a proper part of Lumpl, also may not count. One might also argue that 'there is one material object' comes out true for the same reason as 'there is one piece of clay' and 'there is one statue': whatever unity relation is associated with 'material object' (presumably not a very determinate matter), there is only one object determined by any given stage along this relation. The general point is that counting material objects is a messy business – much more so than counting people or trains. If Lumpl and Goliath are two material objects, then *in some sense*, the number of material objects on the shelf must be greater than one. But there clearly is such a sense, as witnessed by the statue's many material parts. There is also a sense in which the number of objects on the shelf is one, and I have just sketched a few ideas on what that sense might be. The fact that there is only one material object on the shelf therefore does not undermine the non-identity of Lumpl and Goliath.

Cologne; but only the former has the Y-shaped train as counterpart at t_1. Similarly, one might argue that the unity relation for human persons puts greater emphasis on psychological continuity than the relation for human bodies, but that the two only come apart in unusual cases involving things like brain transplantation. The fact that a name picks out an ordinary person then does not tell us whether the counterpart relation associated with the name is the one for persons or the one for bodies.[15]

So to evaluate the truth-conditions of sentences involving intensional operators, we need to know which unity or counterpart relation goes with which referring expression. Lewis ([1971], [2003]) and Sider [2001] seem to suggest that is a matter of pragmatics: 'this person' and 'this body' have the very same semantic value, but the choice of words renders a different counterpart relation salient.

A rather more systematic approach, defended by Geach [1962], Gibbard [1975] and others, treats the unity relation associated with a term as part of the term's semantic value. The semantic value of a term like 'Lumpl' or 'this person' then has at least two components: a *referent* and a *sort*. (Realistically, both of these are often vague and context-dependent.) The referent is the object (if any) picked out by the term; the sort tells us whether this object is picked out *qua* statue, *qua* body, *qua* person, etc. It does not really matter how the sort achieves this task, or what kind of entity it is; the simplest proposal is perhaps to identify sorts with unity relations (or counterpart relations). Like Fregean senses and Carnapian intensions, sorts affect a term's reference at other times and worlds. Unlike senses and intensions, however, sorts fall far short of *determining* reference: merely knowing that a name denotes a person is not enough to figure out its referent, neither here nor at other worlds or times. As Gibbard [1975: 197f.] points out, associating names with sorts as well as referents goes quite naturally with a Kripkean picture of names.[16]

15 If my metaphysical proposal is extended to the modal dimension (which might require a higher degree of modal realism than I am comfortable with), the idea that the unity or counterpart relation associated with a term can be determined by its reference becomes more plausible. The reference then includes the relevant object at other possible worlds, so 'this person' and 'this body' will no longer co-refer. Coreference with different unity relations would still be possible, however, and the relevant unity relations would not have to be co-intensional, for they might come apart for other individuals. Nevertheless, a purely referential account is not out of the question once we include the modal dimension. We could then define counterparthood as a relation between ordinary objects (referents of singular terms), unrelativised by times or worlds or sorts.

16 Gibbard himself defends an "intensional" semantics, in which names are associated with non-trivial functions from worlds or times to referents. This kind of approach is often considered one of the main alternatives to counterpart-theoretic semantics (see e.g. [Fitting 2004], [Kracht and Kutz 2007]). Note that within a four-dimensional setting, my counterpart-theoretic semantics determines *two* intension-like entities. First there is the mapping from times to stages, which is folded into a term's extension. Second, there is the mapping from times to counterparts. This is not part of the term's extension, but determined by the extension and the sort. Neither of these "mappings" are functions from times to individuals: a person can have multiple stages as well as multiple counterparts at t.

Having associated singular terms with sorts and thereby with counterpart relations, it is straightforward to adjust the counterpart-theoretic semantics. When an intensional operator shifts the evaluation time from t_1 to t_2, the reference of any term in its scope shifts to the counterpart of the previous referent(s), along the counterpart relation associated with the term.

We can also reformulate the semantics in terms of an untensed, two-place counterpart relation. Relative to any given sort, let us say that y is a *counterpart (simpliciter)* of x iff there are stages s_x, s_y such that s_x determines x, s_y determines y, and s_x stands in the relevant sortal unity relation to s_y. This is just the doubly tensed definition from section 3 with the two times bound by existential quantifiers. (Hence the concept is easily adopted to endurantism. For example, a person y is a counterpart of a person x iff there are times t_1, t_2 such that y at t_2 is the same person as x at t_1.)

In a case of personal fission, the Y-shaped pre-fission person has three counterparts simpliciter: the two branches and itself. To ensure that in the scope of '*at* t_2' only the two branches count, we stipulate that if a term x is associated with a particular sort, then it always denotes objects of that sort, even in the scope of temporal operators. At t_2, the Y-shaped object is therefore ineligible, because it is no longer a person. That is, it is not determined along the unity relation for persons by any stage at t_2 (because there is no t_2-stage such that the Y-shaped object consists of that stage together with everything unity-related to it).

In general, let us say that an object *belongs to* a sort σ at a time t iff it is determined by a t-stage along the unity relation for σ. Thus relative to any sort σ, y is an eligible counterpart of x at t_2 iff (i) y is a counterpart of x, and (ii) y belongs to σ at t_2. If a temporal operator shifts the time of evaluation from t_1 to t_2, then the reference of singular terms shifts from objects that belong to the relevant sort at t_1 to those of their counterparts that belong to that sort at t_2. Relative to any sort, this is exactly the shift generated by the doubly tensed counterpart relation from section 3. The two formulations are equivalent. The reformulated semantics will, however, make it easier to deal with names for non-present objects – as we will see next.

6 Things that are not present

The interpretation rule for '*at t*' given in section 3 had the side-effect of requiring names and variables to be *local*, meaning that the denoted objects must always exist at the point of evaluation. This is a common requirement in counterpart-theoretic semantics,

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The intensional account rules this out, which is why it cannot handle genuine paradoxes of occasional identity (although it nicely handles the case of Lumpl and Goliath).

as well as modal logic more generally.[17] But it is a severe limitation. In the temporal interpretation, we could not have names like ‘Albert Einstein’ for objects in the past.

I mentioned in section 3 that one problem with non-local names in counterpart semantics disappears on the present proposal: we are not forced to choose any particular stage as the referent of ‘Einstein’. ‘Einstein’ can refer to a complete persisting individual in the past. But we have a different problem. In 1922, Einstein won a Nobel prize. For this to come out true, ‘Einstein’ should refer to Einstein in the scope of ‘in 1922’. According to the rules of section 3, ‘in 1922’ shifts the reference of ‘Einstein’ to the 1922-counterpart of the initial referent at the utterance time. So if ‘Einstein’ initially refers to Einstein, then Einstein must count as a 1922-counterpart of himself today. That is, we have to allow for things to be counterparts at t_2 of themselves at t_1 even if they do not exist at t_1. This is not possible by the definition of the doubly tensed counterpart relation in section 3.

We could extend that definition so that if no ordinary, existing individual at a time t_1 has a given individual x at t_2 as its counterpart, then x itself counts as having, at t_1, x at t_2 as its counterpart. If counterparthood is symmetrical, this amounts to stipulating that if something does not have any existing counterparts at some time, then it shall count as its own counterpart at that time. (See [Forbes 1982], [Forbes 1985] for a proposal along these lines.)

What if Einstein had undergone fission or fusion? Suppose Einstein fissioned into two people in 1955. There are then three candidates for the reference of ‘Einstein’: the Y-shaped object that was a person before the fission, and the two branches that were persons after the fission. Which of these does the name pick out? I suppose it would be the Y-shaped object, although we might of course also have a name for one of the branches. But now suppose the two Einstein successors are still alive. Then there *are* ordinary, existing objects at the present, namely the two branches, which have the original Einstein as their counterpart in 1922. So the above extension does not apply. If ‘Einstein’ is to denote the Y-shaped person in the scope of ‘in 1922’, it now has to denote one of its two successors. We seem forced to conclude that there can be names for genuinely past persons only if they do not have present counterparts. If Einstein’s successors all happen to have deceased, ‘Einstein’ can refer to the person in 1922. It cannot refer to such a person if one of the successors is still around. This does not sound right.

Analogously, consider the example of the train. When the train departs at time t_1 in Berlin, we should be able to introduce names ‘x_1’, ‘x_2’ for the two trains that will arrive in Düsseldorf and Cologne, respectively, at t_2. But the departing train has both of these

17 In fact, many treatments of quantified modal logic, such as [Kripke 1963] and [Lewis 1968], ban individual constants altogether. Some problems specific to non-local names in the context of counterpart-theoretic semantics are discussed in [Ramachandran 1990a], [Ramachandran 1990b] and [Forbes 1990].

t_2 trains as counterpart at t_1, so 'x_1' and 'x_2' would both denote the departing train, and thus both terms would denote both trains in the scope of '*at* t_2', which is not the intended result.

What generates these problems is the assumption that a term for a past or future object must denote something that *presently* represents the object via the counterpart relation. Let us drop this assumption, and with it the artificial stipulation that everything is its own counterpart at times when it does not exist.

Recall the two-place counterpart relation defined at the end of the previous section. On this definition, the Y-shaped Einstein of 1922 has three counterparts in the fission scenario: himself and his two branches. In the scope of '*at* t', reference shifts to those counterparts of the previous referent that belong to the right sort at t. So if 'Einstein' denotes the Y-shaped object, then in the scope of 'in 1922', it denotes those counterparts of the Y-shaped object that are persons in 1922. The only such counterpart is the Y-shaped object itself. So 'Einstein' denotes the 1922 person both inside and outside the scope of 'in 1922' – irrespective of whether he has present counterparts. That's exactly what we wanted.

What is true for names is also true for variables. 'In 1922, there was a person x who entered a duplication machine in 1955 ... ' – here the variable x is introduced in the scope of 'in 1922' to stand for a certain person in 1922. The (initial) value of x that renders the statement true is the Y-shaped person in 1922. The train case also comes out right. 'x_1' and 'x_2' can be introduced to denote the trains that will eventually arrive in Düsseldorf and Cologne; since each of them is their only train counterpart at t_2, the reference does not change in the scope of '*at* t_2'. On the other hand, it does change in the scope of '*at* t_1', where both terms come to denote the train in Berlin. So even at the utterance time t_1, 'p' and '*at* t_1, p' (more colloquially, 'now p') are not equivalent: '$x_1 = x_2$' is false, but '*at* $t_1, x_1{=}x_2$' is true. One could restore the equivalence by treating every sentence as implicitly prefixed by 'now', but I will not do so.[18]

In the appendix, I give a rigorous statement of the full semantics, in a form that is neutral on metaphysical issues such as four-dimensionalism. The point of the exercise is mainly to illustrate how the ideas sketched in this paper can be put together into a

18 [Priest 1995] gives a semantics for a (non-modal) first-order language with ambiguous terms that resembles the paraconsistent variation of my semantics for sentences in the scope of intensional operators. Priest also suggests an application to occasional identity: if 'x' denotes an amoeba that fissions into y and z, then after the fission, the name denotes both y and z. Although Priest does not consider the question, it is natural to assume that operators like 'at t_2' would likewise render occurrences of 'x' in their scope ambiguous, even before the fission. Priest's fission puzzle is different from the puzzles I have discussed in that he looks at unembedded sentences involving 'x' uttered at times after the original referent has fissioned. Priest assumes that reference here shifts to the post-fission amoebae. The name becomes genuinely ambiguous. On the account I favour, 'x' still refers to the Y-shaped object that was an amoeba before the fission.

precise semantics for a rich fragment of ordinary language. Much more would need to be said to defend this particular interpretation, and I have no doubt that it could be improved in various ways. More would also need to be said to apply my proposal directly to English, rather than the language of quantified hybrid logic. But we should not lose sight of the big picture. In some form or other, a counterpart-theoretic semantics along the lines I have defended may provide an attractive solution to the paradox of occasional identity, without committing us to controversial metaphysics or twisting our words.

7 Whither counterpart theory?

Counterpart theory (including its temporal incarnation, stage theory) can explain how seemingly paradoxical statements like (1)–(4) may all be true, and thereby solve the puzzle of occasional identity. But the solution comes at a high price. I have argued that we can get away cheaper by taking the core idea of counterpart-theoretic semantics and embedding it in a more conservative semantical and metaphysical framework.

Now counterpart theory is not advertised merely, or even primarily, by its solution to the paradox of occasional identity. Among other things, it is also said to solve the problem of accidental and temporary intrinsics, explain the indeterminacy and context-dependence of essentialist judgments, and solve paradoxes of coincidence like the case of Lumpl and Goliath ([Lewis 1986: 198–204, 248–259], [Sider 2001: chs.4–5]). I have focused on the paradox of occasional identity because I believe that, along with related puzzles mentioned in section 3, it provides the strongest support specifically for counterpart theory. The other advantages can more easily be matched by alternative accounts.

With respect to paradoxes of coincidence, I have argued in section 5 that a view on which ordinary objects are extended and Lumpl is not identical to Goliath is at least as plausible as the counterpart-theoretic alternative. The problem of accidental and temporary intrinsics is notoriously elusive. If it is a genuine problem, it may indeed require the existence of stages and world-bound individuals to serve as primary bearers of certain intrinsic properties. But this does not entail that ordinary trains and people should be identified with stages or world-bound individuals.

The vagueness and context-dependence of essentialist judgments, it seems to me, can just as well be explained by providing a multitude of potential referents, rather than a multitude of potential counterparts. When counterpart theory says that my use of 'this train' determinately denotes a particular object, but does not fully settle whether this or that object at other worlds or times qualifies as its counterpart, we can instead say that the term is indeterminate between various cross-world or cross-time individuals.

This is not to say that other, more metaphysical considerations could not swing the balance back in favour of counterpart theory. For example, if you think that material objects are nothing but aggregates of (time-slices of) particles, and that there are no

Lewisian possible worlds that could provide particles beyond those provided by actuality, then you may want to identify statues and lumps if they coincide at every time, as there would seem to be only one aggregate of relevant particle slices. This might support some kind of counterpart theory about modality, perhaps along the lines of [Sider 2002]. I suppose extreme presentists and solipsists could run a similar argument for the temporal and spatial dimensions.

My aim in this paper was not to sell you my metaphysics. I mostly want to sell you my semantics. Even if you are a committed counterpart theorist, you might like to swap the translation rules of [Lewis 1968] for a more comprehensive semantics that can handle talk about specific times and worlds, non-local names, and multiple counterpart relations. But of course I would also recommend this semantics if you are *not* a counterpart theorist. You can have almost all the advantages of counterpart theory at almost none of the costs.

Appendix: Formal Semantics

Here I will give a precise formulation of the semantics described in the paper. To keep the task manageable, it is not a semantics for English, but for the standard language $\mathcal{L}$ of quantified hybrid logic, into which the relevant statements of English first have to be regimented.

Sentences of $\mathcal{L}$ are constructed in the usual manner from infinitely many *individual variables and constants* x, y, z, etc., *predicates* $=, F, G, H$, etc. (each associated with an *arity* $\in \mathbb{N}$), *nominals* a, b, c, etc. (serving as names for individual times or worlds etc.), the boolean connectives $\neg$ and $\wedge$, the quantifier $\forall$, the monadic sentence operator $\Box$ and the binary operator *at* that takes a nominal as its first argument and an arbitrary sentence as its second argument.

Expressions of $\mathcal{L}$ are interpreted in *$\mathcal{L}$-structures*, or simply *structures*. A structure has the following components:

1. a non-empty set W (the *points of evaluation*, e.g. worlds or times),
2. a designated member α of W (the actual world, present time, etc.),
3. a binary relation R on W (the *accessibility* relation),
4. a non-empty set S (the *sorts* or *atomic types*),
5. a family U of sets, indexed by $W \times S$ (the world-relative *domains of individuals* for each sort); I write D_w for $\cup_{s \in S} U_{w,s}$ (the total domain of w), D^s for $\cup_{w \in W} U_{w,s}$ (the global domain of sort s), and D for $\cup_{w \in W} \cup_{s \in S} U_{w,s}$ (the total global domain),
6. a family C of relations, indexed by S, such that $C_s \subseteq D^s \times D^s$ (the *counterpart relation for sort s*).

An *initial interpretation of $\mathcal{L}$ on* such a structure is a function V that assigns

1. to each singular term x a pair of a sort and an individual of that sort, i.e. a member of $\{\langle s, d\rangle : s \in S, d \in D^s\}$; I write $[x]^V$ for the individual and $[\![x]\!]^V$ for the sort,
2. to each n-ary predicate F and point $w \in W$, an n-ary relation $V(w, F)$ on D, subject to the restriction that $V(w, =) = \{\langle d, d\rangle : d \in D\}$,
3. to each nominal a a member of W.[19]

An ($\mathcal{L}$-)*model* is a structure $\mathcal{S}$ together with an initial interpretation on $\mathcal{S}$.

Note that sorts are like one-place predicates in that a model associates with each sort s and world w a subset of D_w. One could add that every sort should correspond to a predicate (the corresponding "sortal") with the same range of extensions, but I have not built this into the semantics.

The division of labour between interpretations, structures, and syntactic properties of the language is a bit arbitrary and not meant to carry any great significance. For example, the assignment of sorts to variables (and therefore the set S) could be moved into the syntax, yielding a more traditional many-sorted language. Since the nature of the sorts is unimportant, we could also identify the sorts with the associated counterpart relations.[20]

To complete the semantics, we need to specify under which conditions a sentence is true in a model. To this end, let me first introduce two abbreviations. First, if V is an interpretation, then $V^{[x\mapsto\langle s,d\rangle]}$ is the function that maps x to $\langle s, d\rangle$ and is otherwise just like V; if $\mathbb{V}$ is a set of interpretation functions, then $\mathbb{V}^{[x\mapsto\langle s,d\rangle]} = \{V^{[x\mapsto\langle s,d\rangle]} : V \in \mathbb{V}\}$. Second, an interpretation V' is a *w-image of* an interpretation V (for short: $V \overset{w}{\rightsquigarrow} V'$) iff (i) V and V' agree on all predicates, and (ii) for every singular term x with $s = [\![x]\!]^V$, if there is an individual $d \in U_{w,s}$ such that $[x]^V C_s d$, then $V'(x) = \langle s, d\rangle$ for some such d, otherwise $V'(x)$ is undefined. So a w-image of V' is like V except that the reference of all singular terms is shifted to a counterpart at w (of the right sort) of their reference under V. If there is no such counterpart, the term becomes empty.

If the counterpart relation is *functional*, so that nothing has multiple counterparts at any world w, then there is always just one w-image of a given interpretation V. We could

19 Traditionally, nominals are treated as sentences, i.e. zero-place predicates. The third clause should then say that for any nominal a there is exactly one $w \in W$ such that $V(w, a) = 1$. Here $1 = \{\emptyset\} = \{\langle\rangle\}$ is the unit set of the empty tuple, which is the only zero-tuple from D_w. (In general, a zero-ary predicate denotes, relative to a world w, either $\emptyset = 0 =$ *False*, or $\{\langle\rangle\} = \{\emptyset\} = 1 =$ *True*, which are the two zero-ary relations on D_w.) For simplicity, I identify $V(a)$ with the unique world at which a is true and ignore occurrences of nominals anywhere else than at the first argument-place of *at* .

20 Entirely skipping the sorts and merely associating terms with a counterpart relation would not suffice, unless we make the counterpart relations tensed. For example, in a fission case, Y has three counterparts Y, L and R. If the term x initially denotes Y, and we want to evaluate it at a post-fission time, we need to find counterparts *of the right sort* at that time. Thus we need to know which things are of which sort at any given time, even if there is no predicate associated with the sort. Making counterparthood tensed would help, because we could then say that Y has the two branches as relevant counterparts at t_2, and itself at t_1.

then say that *at* w, Fx is true under interpretation V iff Fx is true under the w-image V' of V.[21] If there are several w-images, we have to consider the truth-value of Fx under all these interpretations. Thus in order to define truth in a model I will define a relation $\Vdash$ between a structure $\mathcal{S}$, an interpretation V, a *set* of interpretations $\mathbb{V}$, a point w, and a sentence A. A is true in model $\langle \mathcal{S}, V \rangle$ iff $\mathcal{S}, V, \{V\}, \alpha \Vdash A$, where α is the designated point of the structure $\mathcal{S}$. Here is the definition of $\Vdash$.

$\mathcal{S}, V, \mathbb{V}, w \Vdash Fx_1 \ldots x_n$	iff there are (not necessarily distinct) $V_1 \ldots V_n \in \mathbb{V}$ such that $\langle [x_1]^{V_1}, \ldots, [x_n]^{V_n} \rangle \in V(w, F)$.
$\mathcal{S}, V, \mathbb{V}, w \Vdash \neg A$	iff $\mathcal{S}, V, \mathbb{V}, w \nVdash A$.
$\mathcal{S}, V, \mathbb{V}, w \Vdash A \wedge B$	iff $\mathcal{S}, V, \mathbb{V}, w \Vdash A$ and $\mathcal{S}, V, \mathbb{V}, w \Vdash B$.
$\mathcal{S}, V, \mathbb{V}, w \Vdash \forall x A$	iff for all $d \in D_w$ there is an $s \in S$ such that $d \in U_{w,s}$ and $\mathcal{S}, V^{[x \mapsto \langle s,d \rangle]}, \mathbb{V}^{[x \mapsto \langle s,d \rangle]}, w \Vdash A$.
$\mathcal{S}, V, \mathbb{V}, w \Vdash$ **at** a, A	iff $\mathcal{S}, V, \mathbb{V}', V(a) \Vdash A$, where $\mathbb{V}' = \{V' : V \overset{V(a)}{\rightsquigarrow} V'\}$.
$\mathcal{S}, V, \mathbb{V}, w \Vdash \Box A$	iff $\mathcal{S}, V, \mathbb{V}', w' \Vdash A$ for all $\mathbb{V}', w'$ such that wRw' and $\mathbb{V}' = \{V' : V \overset{w'}{\rightsquigarrow} V'\}$.

To get a feeling for how this works, let us apply it to the case of the fissioning train. W is the set of times, including the departure time t_1 and some time t_2 when the train has arrived in Cologne and Düsseldorf. The relevant individuals are the Y-shaped object Y that is a train before the division, and its two branches L (towards Cologne) and R (towards Düsseldorf) which are trains after the fission. Assuming that being a train corresponds to sort s, we therefore have $D_{t_1,s} = \{Y\}$ and $D_{t_2,s} = \{L, R\}$ (ignoring other trains). Let α be the departure time t_1. Assume that on the intended interpretation V, 'x' denotes the train at α, i.e. Y, the nominal 't_2' denotes the arrival time t_2, and the predicates 'B', 'C', 'D' apply to things in Berlin, Cologne, and Düsseldorf, respectively. Then 'Bx', for example, is true:

$$\mathcal{S}, V, \{V\}, \alpha \Vdash Bx.$$

This is because Y is in Berlin at t_1, and so $[x]^V \in V(\alpha, B)$. The sort plays no role here. Sorts are only used for the interpretation of *de re* modality. For example,

$$\mathcal{S}, V, \{V\}, \alpha \Vdash \textit{at } t_2, Cx.$$

Here, the interpretation rule for *at* says that $\mathcal{S}, V, \{V\}, \alpha \Vdash \textit{at } t_2, Cx$ iff $\mathcal{S}, V, \mathbb{V}', t_2 \Vdash Cx$, where $\mathbb{V}'$ is the set of t_2-images of V. There might be many such images, but what

21 For ease of discussion, I assume in informal remarks like this that the nominal w in $\mathcal{L}$ picks out the same world as the term w in the meta-language.

matters here is only whether they assign L or R to x, which are the two counterparts of Y of sort s at t_2. So we can assume that $\mathbb{V}' = \{V_L, V_R\}$, where V_R is an arbitrary t_2-image of V with $[x]^{V_L} = L$ and V_R is an arbitrary t_2-image of V with $[x]^{V_R} = R$. By the rule for atomic formulas, $\mathcal{S}, V, \{V_L, V_R\}, t_2 \Vdash_1 Cx$ iff there is a member V' of $\{V_L, V_R\}$ such that $[x]^{V'} \in V(t_2, C)$. Since V_L satisfies this condition, $at\ t_2, Cx$ is true. So is $at\ t_2, Dx$ and $at\ t_2, \neg Bx$.

A somewhat odd feature of the present rules is the sortal blindness of quantification: $\forall x A(x)$ says that everything satisfies $A(x)$ relative to some sort or other; thus for complex formulas $A(x)$, $\forall x A(x)$ does not always entail $A(a)$, which requires that a satisfies $A(x)$ relative to the sort associated with a. The best response to this problem is arguably to replace the quantificational machinery of standard first-order logic by more flexible constructions that not only render quantification sortal (as it is in natural language) but also allow for more perspicuous representations of *de re* modality.

Various further alternatives to the present semantics are possible that would not require a change in syntax. As usual in intensional semantics, we have to decide whether domains should be constant or variable, how to handle empty names, and whether singular terms and predicates should be local or non-local. On the account above, domains are variable, predications with empty terms are always false, and both terms and predicates are non-local in the sense that their initial extension is not enforced to lie in the domain of the designated point α. These choices are largely independent of my main proposal, which concerns the shift of extensions under intensional operators.

With respect to the counterpart-theoretic aspect of the semantics, we face the questions mentioned in section 2 of whether to require truth on *some* image or truth on *all* images, whether to allow for mixed "disambiguations", and how "ambiguous" expressions shall interact with logical operators. The above rules could easily be adjusted to all these options. Another question is whether iterated intensional operators shift the reference of a term to counterparts of counterparts, or only to counterparts of the original referent. For example, does '$at\ t_1, at\ t_2, Fx$' state that some t_2 counterpart of some t_1 counterpart of x is F, or that some t_2 counterpart of x is F? I have chosen the second answer, mainly because it avoids certain problems when an individual has no counterpart at in-between points: even if the train to Cologne is dismantled in the evening, it could be true that at midnight, a man is going to die who was on the train six hours before. This is why the unshifted interpretation function V is dragged along in the recursive definition of truth.

A side-effect of this last choice is that one can easily define an expression '@' which functions as an "undo" operator for intensional shifts. I do not think such an operator exists in ordinary language, but some philosophers have found it useful, and there has been some debate about whether it can be added to a counterpart-theoretic language (see [Hazen 1979], [Fara and Williamson 2005], [Ramachandran 2008], [Sider 2008], [Russell 2013]). In the present framework, the task is easy. We can simply say that

$\mathcal{S}, V, \mathbb{V}, w \Vdash @A$ iff $\mathcal{S}, V, \{V\}, \alpha \Vdash A$.

So $\Diamond\exists x @Fx$, for example, is true iff some individual x at some point *itself* satisfies F at the designated point α. It does not matter whether x has several counterparts at α, or whether it has none at all, since the semantics of '@' does not track individuals via the counterpart relation.

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