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## Relativity and Persistence

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## **Abstract**

The nature of persistence of physical objects over time has been intensely debated in contemporary metaphysics. The two opposite views are widely known as “endurantism” (or “three-dimensionalism”) and “perdurantism” (“four-dimensionalism”). According to the former, objects are extended in three spatial dimensions and persist through time by being wholly present at any moment at which they exist. On the rival account, objects are extended both in space and time and persist by having “temporal parts,” no part being present at more than one time. Relativistic considerations seem highly relevant to this debate. But they have played little role in it so far. This paper seeks to remedy that situation. I argue that considerations based on the special theory of relativity and the notion of coexistence favor perdurantism over endurantism.

**1. Introduction.** Ordinary physical objects persist over time and survive change. How do they manage to do so? One view, known as *endurantism*, or “three-dimensionalism” (3D), holds that objects persist by being *wholly present* at different moments of time. On this view, objects are three-dimensional entities that do not have “temporal extension.” It is literally one and the same 3D object that is wholly present at  $t_1$ ,  $t_2$ , and all other times at which it exists. When it is at  $t_2$ , it is no longer present at  $t_1$ , neither is any part of it. Enduring objects undergo change in the old Aristotelian way, by losing and acquiring properties with time: one and the same object  $E$  is  $F$  at  $t_1$  and  $\sim F$  at  $t_2$ .

Some philosophers have argued that this account of change flies in the face of Leibniz’s principle of Indiscernibility of Identicals,  $x = y \supset (F) (Fx \equiv Fy)$ , or, rather, its corollary, the Non-Identity of Discernibles:  $\exists F (Fx \& \sim Fy) \supset x \neq y$ . If something has different properties at different times, it cannot be one and the same thing. Hence, nothing can literally survive change. Considerations of this sort have been instrumental in promoting a different theory of persistence known as *perdurantism*, or “four-dimensionalism” (4D).

Objects are said to perdure if they persist by virtue of having *temporal parts*, or stages, at different times, no part being fully present at more than one time. On this view, objects are four-dimensional beings: they are extended both in space and time. Persistence of perduring objects is not a matter of strict transtemporal identity, because, in the four-dimensional ontology, nothing can be present at two different times. Instead of literal identity over time, one has to speak of a mereological relation *being a temporal part of the same 4D entity as*. Change becomes a matter of having different temporal parts instantiating different properties. To say that a perduring object  $P$  is  $F$  at  $t_1$  and  $\sim F$  at  $t_2$  is just to say that

(1) P has two temporal parts, P1 and P2; (2) P1 exists at  $t_1$  (and only at  $t_1$ ), P2 exists at  $t_2$  (and only at  $t_2$ ); (3) P1 is  $F$  and P2 is  $\sim F$ . Since nothing exists at more than one time, nothing is saddled with incompatible properties, thus salvaging the Leibnizian doctrine.

Perdurantists insist that the notion of temporal part is no more problematic than the notion of spatial part. If you know what the latter is, you know what the former is. In many ways, four-dimensionalism puts time on a par with space. Just as being extended in space involves having spatial parts, being extended in time involves having temporal parts.

Ascribing a property to a 4D object at a certain time really amounts to ascribing that property to one of its temporal parts, just as attributing a property to a spatially extended object often means attributing that property to one of its spatial parts. To say that the river is narrow (or dirty) at the town line means that the river has a spatial part that is narrow (dirty). Similarly, to say that a perduring poker is red-hot at  $t$  really means that the poker has a  $t$ -part that is red-hot.

The 3D/4D debate has become a hot topic in contemporary metaphysics.<sup>1</sup> Relativistic considerations seem highly relevant to the debate: the idea of “putting time on a par with space” surely smacks of relativity. Surprisingly enough, such considerations have played little role in the discussion about persistence so far. In fact, the discussion largely proceeds as if there were no relativity theory around. The language in which the issue is normally framed is essentially pre-relativistic. Thus the very notion of being wholly present at a moment of time is a Newtonian notion par excellence.

The purpose of this paper is twofold: (1) to reformulate the 3D/4D issue in the four-dimensional space-time framework and (2) to show that considerations of special relativity

(SR) favor perdurantism over endurantism. In the context of endurantism, (1) requires replacing the notion of being wholly present at a time by the notion of being wholly present at a space-time point or region or, alternatively, the notion of the occupation of a space-time point or region by an enduring object. Correspondingly, the perdurantist notion of a temporal part will have to give way to that of a spatio-temporal part. Equipped with these ideas, one can employ the contemporary formalism of space-time theories. Various physical theories, such as classical mechanics and SR, are distinguished by intrinsic structures they impose on the space-time manifold. Different view of persistence over time can then be formulated in terms of specific relations between space-time points or regions occupied by enduring and perduring objects, the relations available in a particular space-time theory.

Given this background, one might be tempted to claim that the conclusion to be established, that SR favors 4D over 3D, is gratuitous—that the relativistic four-dimensional framework of events, world-lines, or world-regions naturally requires a four-dimensional ontology of perdurantism. This temptation should be resisted. The mere fact that space and time are blended together in a single manifold cannot, by itself, decide the issue between 3D and 4D. Even a thoroughgoing realism about neo-Newtonian or even Minkowski space-time is consistent with endurantism. True, objects, or their life careers, can be usefully represented, in such a framework, by world-lines (or full-blown four-dimensional “world-worms”). But it will be premature to conclude that this representation commits one to a four-dimensional ontology of objects. To see this, one should only note that the same three-dimensional enduring object can occupy (be wholly present at) different disjoint regions of

space-time (see, in this connection, van Inwagen 1990). To show that SR privileges 3D over 4D, one has to say a lot more. One should produce a substantive argument to this effect.

The argument of this paper is based on the notion of *coexistence*. The idea is that any reasonable ontology must accommodate the concept of coexistence. In the space-time framework, coexistence must be grounded in relations between points (regions) occupied by enduring or perduring objects. I start by showing how the endurantist and the perdurantist could effect such grounding in neo-Newtonian space-time. This will give us a handle on important notions and requirements one could impose on the notion of coexistence. I then turn to Minkowski space-time and show that, not surprisingly, the relativistic framework proves to be ready-made for the four-dimensional ontology of perdurantism and rather hostile to the endurantist. She can accommodate the notion of coexistence in that framework only at the cost of renouncing central endurantist intuitions.

**2. Coexistence.** The notion of coexistence is central to the metaphysics of objects, just as the notion of becoming is central to the metaphysics of events and to the philosophy of time. Whereas becoming is a fundamental relation between or among events, coexistence is an equally fundamental relation between or among objects. Coexistence is to objects as becoming is to events.

I take it to be uncontroversial that any viable ontology of objects must embrace the concept of coexistence. This assumption is quite general and neutral with respect to the endurance versus perdurance controversy. The endurantist and the perdurantist would certainly want to *construe* coexistence (or the lack of it) differently. But no one of them

would be willing to deny, on pain of solipsism, that she coexists with various objects—tables and chairs, as well as other persons—and no one would be inclined to admit that, in any interesting sense of coexistence, she coexists with all of them indiscriminately. Whether objects endure or perdure, there must be a sense of the coexistence relation such that I bear this relation to Jordan’s present king Abdullah bin Al Hussein but not to his father, the late King Hussein, or to the Babylonian king Nebuchadnezzar, for that matter. Both parties to the debate about persistence would agree that coexistence must be a non-trivial (i.e., neither empty nor universal) relation between objects.

They would, however, disagree on the way in which the notion of time must figure in the concept of coexistence. The endurantist concept of coexistence is tensed or “temporally-loaded” in a way in which the perdurantist one is not. It is tensed, because it holds between entities that change their position in space with time and, consequently, coexistence itself becomes a function of time. For example, if I am wholly present today, then I coexist with King Abdullah wholly present today but not with him wholly present tomorrow.

The perdurantist notion of coexistence is different because it holds between entities that do not change their locations with time. Such entities are either 3D (spatio-)temporal parts of 4D things or four-dimensional wholes “permanently” confined to their spatio-temporal locations. There is no question here of something *coming to coexist* with something else. If I am a perduring object, I cannot say that I came to coexist with Abdullah when I was born, and that this coexistence will cease to take place when one of us dies. This would be appropriate if I were a 3D object that could be wholly present at more than one time. But four-dimensional entities do not really come to be or go out of existence. Each of them just

has a particular temporal extension. Whether such entities, or their parts, coexist is a completely tenseless, or atemporal, issue.

The task of the endurantist, therefore, is to provide a tensed, or temporally-loaded (in this special sense), and non-trivial notion of coexistence in a particular space-time framework, and the task of the perdurantist is to provide a tenseless such notion. I first show that both succeed in doing so in neo-Newtonian space-time. I then turn to Minkowski space-time and argue that, whereas the perdurantist can easily fulfil her task there as well, the endurantist confronts difficulties in the attempt to do justice both to special relativity and the 3D ontology.

**3. Neo-Newtonian Space-Time.** I would like to start by making a useful idealization and imposing certain general requirements on the notion of coexistence.

*Idealization:* From now on we will be dealing with point-like enduring and perduring objects, which do not have spatial extension. This does not detract from the generality of the analysis but makes it much simpler.

*Symmetry:* The coexistence relation  $C$  must be *symmetric*. An account on which  $x$  coexists with  $y$ ,  $C(x, y)$ , but  $y$  does not coexist with  $x$ ,  $\sim C(y, x)$ , would hardly have anything to do with the notion of coexistence.

*Objectivity:* Given two objects (or their momentary parts, in case of perdurantism) having particular locations in space-time, there must be a fact of the matter about their coexistence.

Consider two point-like enduring objects E1 and E2 and their world lines representing their spatio-temporal careers in space-time. The endurantist would certainly want to say that, in a wide variety of cases, these objects would coexist. What are necessary conditions of the coexistence of E1 and E2? Given that enduring objects are wholly present at single points of their histories, they cannot coexist unless they are, in *some* sense, *co-present* to one another. To put it differently, coexistence of enduring objects must be grounded in some relation  $R$  between their momentary spatio-temporal locations O1 and O2—a relation that would express the fact of their co-presence.

In the classical neo-Newtonian framework, co-presence was entirely unproblematic. E1 and E2 could be said to coexist just in case they both exist *at the same time*, or belong to the same “present.” More formally, neo-Newtonian space-time is uniquely decomposable into the set  $\mathcal{S}$  of hyperplanes of *absolute* simultaneity,  $\mathcal{S} = \{ \text{HPS}^{t_{\text{abs}}} \}$ , where  $t_{\text{abs}}$  is the absolute Newtonian time. In this pre-relativistic framework, relation  $R$  could be defined as follows:

$$R^N(O1, O2) \leftrightarrow (\exists t_{\text{abs}})(O1 \in \text{HPS}^{t_{\text{abs}}} \ \& \ O2 \in \text{HPS}^{t_{\text{abs}}})$$

and the corresponding principle of coexistence for enduring objects would be (‘N’ standing for “neo-Newtonian”):

$$(CE^N) \text{ Two enduring objects coexist iff they are co-present to one another, that is, iff their locations belong to the same HPS}^{t_{\text{abs}}} : CE^N(E1^{O1}, E2^{O2}) \leftrightarrow R^N(O1, O2).$$

Here ‘E1<sup>O1</sup>’ and ‘E2<sup>O2</sup>’ denote enduring objects E1 and E2 located at O1 and O2 respectively. The relation of coexistence  $CE^N$  defined in this way is symmetric because it is grounded in the symmetric relation  $R^N$ .  $CE^N$  is also transitive:

$CE^N(E1^{O1}, E2^{O2}) \& CE^N(E2^{O2}, E3^{O3}) \rightarrow CE^N(E1^{O1}, E3^{O3})$ . In general, on this pre-relativistic view, every enduring object coexists with any other in virtue of being co-present with it in every reference frame.

Turning now to the perdurantist ontology, one could formulate two distinct principles of coexistence in the classical framework.

$(CP_1^N)$  Two momentary parts of perduring objects coexist iff they are co-present to one another, that is, iff their locations belong to the same  $HPS^{f_{abs}}$  :

$$CP_1^N(P1^{O1}, P2^{O2}) \leftrightarrow R^N(O1, O2).$$

Here ‘ $P1^{O1}$ ’ and ‘ $P2^{O2}$ ’ denote momentary spatio-temporal parts of two perduring objects P1 and P2 located at O1 and O2 respectively.  $CP_1^N$  is symmetric and transitive.

The perdurantist may also be interested in another notion of coexistence applying to entire 4D objects, rather than to their momentary 3D parts:

$(CP_2^N)$  Two perduring objects coexist iff they have co-present momentary parts whose locations belong to the same  $HPS^{f_{abs}}$  :

$$CP_2^N(P1, P2) \leftrightarrow \exists P1^{O1} \exists P1^{O2} (P1^{O1} \in P1 \& P2^{O2} \in P2 \& R^N(O1, O2)).$$

To put it informally, four-dimensional perduring objects related by  $CP_2^N$  temporally “overlap.”

$CP_2^N$  is symmetric but not transitive. But there is no reason to expect, or require, transitivity of this relation of coexistence. I coexist or “overlap,” in the sense of  $CP_2^N$ , with my father, and he “overlaps” with my grandfather, but I don’t “overlap” with my grandfather, and this is anything but surprising.

These simple accounts of coexistence become inadequate in the relativistic context where there is no place for absolute simultaneity. Two enduring objects, or two momentary parts of perduring objects, may be “co-present” (that is, their spatio-temporal locations may be simultaneous) in one (inertial) reference frame but not in another. To express their coexistence, one can no longer rely on relation  $R^N$  holding in *every* reference frame if it holds in *any*. This does not mean that no other relation  $R$  can be singled out to ground the coexistence of objects (or of their parts) in an objective and relevant way. In it clear, however, that all such relations must themselves be grounded in the invariant structure of Minkowski space-time.

**4. Minkowski Space-Time.** The most natural candidate for  $R$  is surely the relation of space-like separation:

$$R(O1,O2) \leftrightarrow \eta(O1,O2) < 0$$

This suggests the following candidate principles of coexistence for enduring and perduring objects (and the latter’s parts) in Minkowski space-time:

(CE) Two enduring objects coexist iff their locations are space-like separated:

$$CE(E1^{O1}, E2^{O2}) \leftrightarrow R(O1, O2).$$

(CP<sub>1</sub>) Two parts of perduring objects coexist iff their locations are space-like

$$\text{separated: } CP_1(P1^{O1}, P2^{O2}) \leftrightarrow R(O1, O2).$$

(CP<sub>2</sub>) Two perduring objects coexist iff they have space-like separated parts:

$$CP_2(P1, P2) \leftrightarrow \exists P1^{O1} \exists P1^{O2} (P1^{O1} \in P1 \& P2^{O2} \in P2 \& R(O1, O2)).$$

We now have to investigate whether each of these candidates is acceptable as a principle of coexistence for a corresponding type of entity in the relativistic context. Let us begin with  $CP_2$ . Being a relativistic counterpart of  $CP_2^N$ , it expresses the idea of “overlap” in a Lorentz-invariant language: instead of a literal temporal overlap, it refers to a relativistic “overlap” of the light cones. The relation of coexistence governed by  $CP_2$  is objective in the sense specified above: given two perduring objects, there is a fact of the matter about their coexistence (“overlap”).  $CP_2$  is obviously symmetric. Just like its classical counterpart, it is not transitive. But this is good news: If  $CP_2$  were transitive, it would hold between any two perduring objects whatsoever and thus be trivial.

$CP_1$  does not fare equally well in this regard. Whereas relation  $CP_1^N$  expressed by its pre-relativistic counterpart is transitive, that expressed by  $CP_1$  is not. But in making a transition to the relativistic context, one has to be prepared—regardless of whether one is an endurantist or a perdurantist—to make some changes in the notion of coexistence. One should not expect this notion to emerge completely intact from the transition at hand. Another notable difference between  $CP_1$  and its classical predecessor,  $CP_1^N$ , is that, on  $CP_1$ , a given part of one perduring object coexists, in general, with infinitely many parts of another object.

Turning now to CE, notice, first, that it also emerges whittled-down from the transition to the relativistic context. Just like its perdurantist analog  $CP_1$ , it does not allow to preserve transitivity of the coexistence relation. The important distinction between them, however, lies in their different attitudes to the role of time. As already noted, the notion of coexistence pertinent to the endurantist ontology is tensed, or temporally-loaded, in a way in

which the corresponding perdurantist notion is not. These features are preserved in the relativistic context, except that the function of the absolute Newtonian time is now played by the *proper* time associated with the state of motion of individual (inertial) enduring objects, or with the orientation of the (inertial) world lines representing individual perduring objects.

To see this, note, again, that coexistence of enduring objects holds between entities fully present at single moments of their proper times. Therefore, the coexistence relation itself becomes a function of these times. I-now (according my clock) coexist with the 4244-years-old Crab Nebula (according to its clock). But the 4000-years-old Crab Nebula does not coexist with me-now. In fact, it does not coexist with me at all, as there is no space-time point at which I am wholly present such that it is space-like separated from the point occupied by the 4000-years-old Crab Nebula. Consequently, there is a sense in which the Crab Nebula *comes* to coexist with me at a moment in its life career measured by the proper time elapsed since its birth in the explosion of a famous supernova. It is in this respect that coexistence of enduring objects regulated by CE is a tensed or temporally-loaded notion.

On the contrary, there is no sense in which any momentary part of the four-dimensional Crab Nebula “comes” to coexist with any part of me. There is also no sense in which the whole perduring Crab Nebula ever comes to coexist with any other perduring object in the universe. Four-dimensional objects and their parts do not change their spatio-temporal locations in the way three-dimensional enduring objects do. Their coexistence, as regulated by CP<sub>1</sub> and CP<sub>2</sub>, is a tenseless, or atemporal, notion.

The difference is crucial. To get a sense of what it involves, notice that whereas on CP<sub>1</sub>, a given part of one perduring object can coexist, as already mentioned, with many parts

of another perduring object, a given enduring object can, on CE, coexist with another enduring object *more than once*. Thus, E2 coexists with E1 located at O1 *both* when E2 is at O2<sup>(1)</sup> *and* when it is at O2<sup>(2)</sup> (Figure 1), because both O2<sup>(1)</sup> and O2<sup>(2)</sup> are space-like separated from O1. For example, the 4244-years-old Crab Nebula coexists both with me-now and me-tomorrow. Indeed, it probably coexists with me when I am wholly present at any time at which I exist. This ontological latitude, as I will show in a moment, is potentially damaging to the endurantist ontology. A cure, I will argue, can only be purchased at the cost of renouncing some important endurantist intuitions.

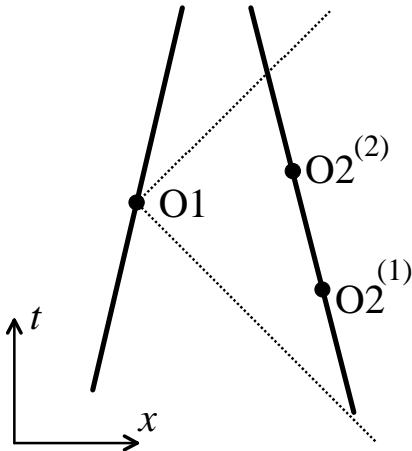


Figure 1: E1, when it is at O1, coexists with E2, when the latter is at any point in the topological present of O1, in particular, when it is at O2<sup>(1)</sup> *and* when it is at O2<sup>(2)</sup>.

**5. Coexistence\*.** Certain enduring things, but no perduring ones, come to be and cease to exist. In-between, they enter into various relations of coexistence with other enduring things. For a given enduring object, the changing relations of coexistence it enters into during its life career provide a changing perspective on the rest of the existence, a dynamic “window” through which such an object “views” the world.

To make these ideas precise, let us go back to the neo-Newtonian framework and introduce the notion of Coexistence<sup>N\*</sup>, based on a straightforward generalization of CE<sup>N</sup>.

CE<sup>N\*</sup>: An enduring object E2 coexists<sup>N\*</sup> with E1 fully present at O1 just in case there is a point O2 absolutely simultaneous with O1, such that E2 is fully present at O2:  $CE^{N*}(E2, E1^{O1}) \leftrightarrow \exists E2^{O2} R^N(O1, O2)$ .

Another way to express the idea of Coexistence<sup>N\*</sup> is by saying that E2 coexists<sup>N\*</sup> with E1 fully present at O1 if and only if the absolute present of O1 includes some part of E2's world line.

To illustrate, King Abdullah, but neither King Hussein, nor Abdullah's grandson, coexists<sup>N\*</sup> with me-now (Figure 2a),<sup>2</sup> where 'now' refers to 13 February 1999.

Consequently, if I am an enduring object fully present at a particular moment of universal Newtonian time, there is a sense in which all other transient enduring beings sort themselves out into three different categories: those that *no longer* exist (e.g., King Hussein), those that are *still* or *already* in existence (e.g., King Abdullah), and those that do *not yet* exist (e.g., Abdullah's grandson). It is clear that this difference with respect to existence is grounded in the fact that only objects in the second category, and not those in the first and in the third ones, bear a certain relation of coexistence with me-now, namely, the relation of Coexistence<sup>N\*</sup>.

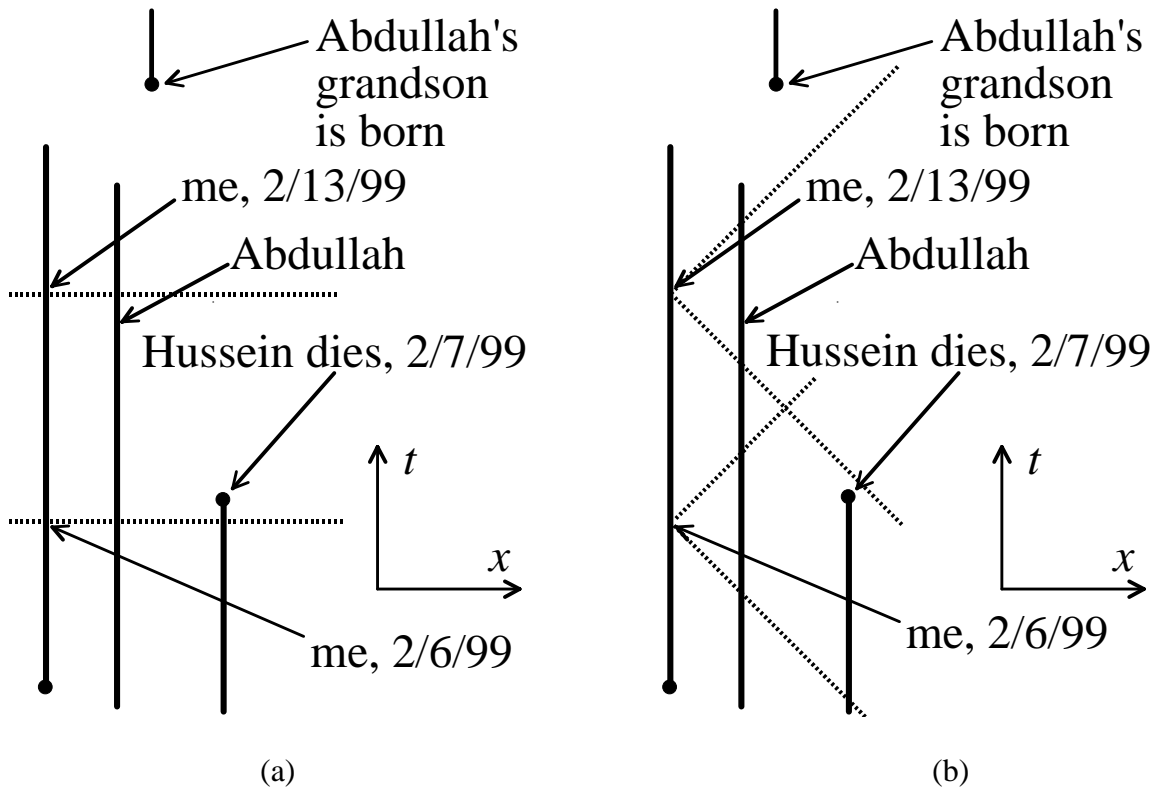


Figure 2: The endurantist changing perspective on existence. *When I am fully present on 13 February 1999, King Abdullah is still (already) in existence, his grandson not yet, and King Hussein no longer. When I was fully present a week ago, both Abdullah and King Hussein were in existence.* (a) Neo-Newtonian account. (b) Relativistic account.

I submit that the endurantist who wants to adjust his views to the relativistic context needs a relativistic analog of Coexistence<sup>N\*</sup> that would allow him to preserve, in that context, important tense-involving intuitions regarding the transient existence of objects other than himself—objects such as King Hussein and Abdullah, which come to be and cease to exist.

The relativistic counterpart of Coexistence<sup>N\*</sup> is a straightforward existential generalization of CE:

(CE\*) An enduring object E2 coexists\* with E1 fully present at O1 just in case there is a point O2 such that E2 is fully present at O2 and O2 is space-like separated from O1:  $CE^*(E2, E1^{O1}) \leftrightarrow \exists E2^{O2} R(O1, O2)$ .

Another way to express the idea of Coexistence\* is by saying that E2 coexists\* with E1 fully present at O1 if and only if the “elsewhere” of O1 includes some part of E2’s world line.

Clearly, the concept of Coexistence\* does precisely the same job in the relativistic framework as the concept of Coexistence<sup>N\*</sup> does in the new-Newtonian context. The point of introducing Coexistence\* is to provide a relativistic basis for a belief to which, arguably, the endurantist is committed: that the existence of other transient things goes hand in hand with her coexistence with them. Thus, if I am an enduring object fully present at a particular time *and place* (viz., here and now), there is a sense in which some other transient enduring objects exist *no longer* (King Hussein) or *not yet* (Abdullah’s grandson)—because they do not bear the relation CE\* to me-now, whereas yet others are *still* or *already* in existence (Abdullah)—because they do coexist\* with me-now. Like its classical predecessor, Coexistence\* effectively changes the membership of the set of objects still or already in existence (and, hence, of those no longer and not yet in it) with time, namely, the proper time of a given enduring object. King Hussein is no longer in existence for me-now. But he was still in existence, together with Abdullah, former Crown Prince Hassan, and others, when I was fully present just a week ago. See Figure 2b.

Notably, tensed determinations, such as “still in existence” and “already in existence,” become, in the Minkowski world, relative to a spatio-temporal perspective and not to a merely temporal one (as they were in the Newtonian world). Nonetheless, the question of *what* objects are still or already in existence admits of a definite answer from *any* such perspective. Thanks to CE and its direct descendant, CE\*, the important distinction between things that are (from the point of view of any enduring object at any point of its spatio-temporal career) still or already in existence and those that are not (any longer or yet) has a firm grounding in the invariant structure of Minkowski space-time.

Let me now reveal the troublesome aspect of these temporal determinations. The trouble comes, in effect, from the “if” part of CE\* (and of its ancestor CE) conjoined with the above considerations linking Coexistence\* with the existence of transient things surrounding a given enduring object. If an enduring object E1 is at O1, *all* other objects whose world lines are at least partly swept by the “elsewhere” of O1 are *still* or *already* in existence. They are *equally* in existence. Such ontological generosity comes from replacing the absolute present of Newtonian physics with the much more extensive topological present of SR. What are the implications of such generosity for the metaphysics of endurantism?

Suppose I am an enduring object fully present at O somewhere on Betelgeuse. I have to conclude, based on the above, that King Hussein *still* exists *and* his great-grandson *already* exists. But clearly, there is no *tensed* sense in which they can be in existence together: King Hussein’s end lies in the *absolute past* of his great-grandson’s beginning. My conclusion, informed as it is by relativistic considerations, is in strange discord with that relativistically invariant fact (Figure 3).

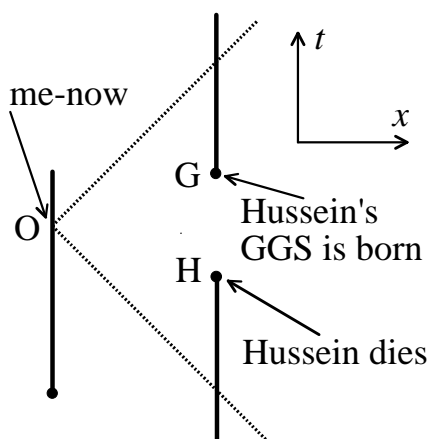


Figure 3: I coexist\*, when I am fully present at O, with both King Hussein and his great-grandson.

On the other hand, there is a rather innocent tenseless sense, appropriate for the perdurantist ontology, in which King Hussein and his great-grandson are both in existence and one of my parts coexists-P\* with both. ‘Coexists-P\*’ here refers to the perdurantist counterpart of Coexistence\* governed by the following principle:

- (CP\*) A perduring object P2 coexists-P\* with the O1-part of another perduring object P1 iff P2 has a part located at a point O2 space-like separated from O1:  
 $CP^*(P2, P1^{O1}) \leftrightarrow \exists P2^{O2} (P2^{O2} \in P2 \& R(O1, O2)).$

My O-part, King Hussein’s last part, and his great-grandson’s first part all exist atemporally in Minkowski world and are related in a manner that does not imply any temporally-loaded determinations, such as “still” and “already.” It is not the case that Hussein’s great-grandson *already* exists and Hussein himself *still* does. They simply exist, as being confined to their spatio-temporal regions, and the fact that my O-part coexists-P\* with both is a further tenseless fact about King Hussein, his great-grandson, and a part of me.

The notion of being fully present at a space-time point (or a space-time region, in the case of real-life, i.e., spatially extended, enduring objects) retains its central place in the endurantist ontology even in the relativistic context. *Being fully present at a time and place*, just as its Newtonian predecessor *being fully present at a time*, is, in fact, part and parcel of the very concept of endurance. From the endurantist standpoint, my full presence at a certain time on 13 February 1999 in Houston (Texas, USA, Earth, Solar System, etc.) is the most important fact about my existence, a fact firm enough to ground my perspective on the existence of everything else. To the extent that endurantism may succeed in incorporating an interesting notion of coexistence in the relativistic framework, this notion becomes the only bridge that connects the existence of a given enduring object with the rest of the universe. But this bridge turns out to be *too wide*. It connects me with things that cannot be in existence together in any temporally-loaded sense of “together.”<sup>3</sup>

**6. Conclusion.** I conclude that the perdurantist is far better equipped for accommodating the notion of coexistence in the context of SR than the endurantist. Since this notion is indispensable to any non-solipsist ontology, the endurantist may be hard-pressed to respond to this relativistic challenge.

## REFERENCES

Sider, Ted (1997), "Four-Dimensionalism," *The Philosophical Review* 106: 197–231.

Van Inwagen, Peter (1990), "Four-dimensional Objects," *Noûs* 24: 245–255.

## FOOTNOTES

1. The literature on the subject is extensive. For a recent contribution and many useful references see Sider 1997.
2. I have made no attempt to draw Figures 2 and 3 to “scale.”
3. In his commentary at the 1998 PSA symposium on Special Relativity and Ontology, Rob Clifton argued that it is hard to see how the objects on the other side of the coexistence bridge must be “in existence together,” once we have abandoned transitivity of coexistence. My reply is that they are “in existence together,” not with respect to one another, but with respect to a third object. If I am an enduring object, I am fully present at a single moment of my proper time. Being thus fully present here and now, I am forced, on pain of solipsism, to grant existence to other things around me, including things that cannot be both in existence together in any temporally interesting sense.