

# Tenses, Changes, and Space-Time

Jan Faye  
Department of Media, Cognition, and Communication  
University of Copenhagen

The language of time contains two distinct ways of talking about events – each claimed to be crucial for any metaphysics of time. The tensed view holds that the notions of *past*, *present*, and *future* are indispensable for our understanding of what time is, and that all tensed expressions reflect this way of thinking.

The tenseless view maintains that what is required to grasp time is only the deployment of the notion of *later* or *earlier* (together with that of *simultaneity*). Both views are taken to exclude one another. If you believe in the tensed view you are a tensor, and if you believe in the tenseless view you are a detenser. A proponent of the tensed view says that there are tensed facts which changes all the time, and which makes tensed and tenseless sentences true and false, but a detenser denies transitory facts and claims them to be tenseless instead, believing that they provide tensed and tenseless sentences with a truth value. Therefore the tensed view is associated with a dynamic view of time, and the tenseless view is connected with a static view of time.

There is a notorious argument against being a tensor. This is McTaggart's argument opposing the reality of time in which he proves that the A-series is inconsistent. McTaggart was, however, both right and wrong at the same time. Time is not real, I shall argue, in the sense that it has a concrete physical

nature. On the contrary, time is an abstract entity that supervenes on concrete happenings. By assuming that time instants and events are identical, McTaggart was able to generate an inconsistency because he assumed that past, present and future are properties of events and therefore properties of real time instants. But if we make a reasonable distinction between time instants and events, we may, on the one hand, say about time instants, now being abstract, that they can be ordered in terms of tenseless relations and that they exist tenselessly with respect to each other. On the other hand, we may say about concrete events that *they* can be past, present or future, not as having an intrinsic temporal property, but in relation to a conscious being.

Here I develop the idea, which I have presented elsewhere, that time instants are abstract entities existing tenselessly and therefore that events and changes likewise may be said to exist tenselessly in virtue of their place at a certain space-time point.<sup>1</sup> We need a notion of time, which I claim is an abstraction from events, to be able to talk about the change and persistence of individual objects with respect to the set of changes and events as such. We therefore say that *particular* objects are in time, meaning that they are parts of the set of all changing things. Thus, a persisting object is one that may undergo changes, while it continues to stay the same during its changes. Time, however, is not only a set but an ordered set, every instant is ordered with respect to every other, and therefore we can use the same order to order particular events. A particular event happens before or after any other

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<sup>1</sup> Faye (2006) and Faye (2007)

particular event because the particular time instants, which they occupy, are defined as earlier and later. But where does the temporal order come from? The order arises as an abstraction from a relation between concrete events. In general, events do causally or perceptually succeed each other and therefore belong to different sets of coexisting events, and therefore using this order we can ascribe a unique order to space-time in relation to all possible inertial observers.

### ***Is time real or transcendental?***

In contrast to any other phenomena, space and time seem to be all pervading. Every physical object is in space and time, and even our thoughts happen to exist in time if not in space. Newton argued that the encompassing nature of space and time is due to the fact that they are like containers in which all material things exist and develop. Space and time are absolute in virtue of being something like real, immaterial substances and by having an invariant metrical structure. Newton even went along and identified space and time with the God's sensory system. Modern space-time physics, in particular the General Theory of Relativity, seems to confirm Newton's view that space and time, or rather space-time, is a real physical entity. But differently from the classical view, space-time is now closely connected with the distribution of matter and energy as stated by Einstein's field equations. How closely they are connected is a matter of debate. According to some physicists, they are

causally linked such that space-time was created together with the rest of the universe during the Big Bang.

Thus, modern physics seems to support a realist interpretation of space and time. Space and time are objective, mind-independent entities, which can be studied like any other physical object. We can make empirical discoveries about space-time and therefore we must adjust our notions of space and time according to our best physical theories.

There exists, however, a completely different view. After Kant had endorsed Newton's absolute view on space and time, he turned critical, and part of his way of addressing Hume's scepticism was to change the ontological status of these fundamental entities. Kant now believed that the pervasiveness of time and space could be explained by assuming that space and time are a priori forms of intuition which permeate all our sense impressions. Space and time are the subjective conditions of perception in the sense that they form the transcendental possibilities for our experience of the empirical reality. Thus, our notions of space and time do not apply to entities of which we can make empirical discoveries. Rather they are necessary and eternal "forms of perception" which do not reflect the empirical world but only the rational man's logical and mental set up.

In a way both Newton and Kant considered space and time to be absolute. To Newton space and time were immovable and eternal because they were not part of God's creation. Kant believed the same although not in terms of objective existing entities but in terms of the *eternal* constitution of the

rational intellect. I think, however, that there are problems with each of these ontological theories.

In my opinion our notions of space and time reflect the fact that physical things exist, move around, and undergo changes. I believe Aristotle was right when he argued that time ontologically depends on motion although it could not be identified with motion. Rather time is the measure of motion. So, according to such a view, it is metaphysically impossible for space and time to exist separable from changes and motion. But this does not imply that they are eternal part of our rational constitution. Our notions of space and time change consistently with what we can say about physical things and their behaviour based on our best (physical) theories of the world.

Thus, on the one hand, I reject the substantialist view on which space and time are concrete physical particulars in their own right. On the other hand, I hold that space and time are not reducible to mere physical relations between physical things. Space and time possess properties which are different from any mental or physical property. What I argue is that space and time are abstract entities which supervene on concrete particulars. Being abstract, if true, means that time instants cannot change between being past, present, and future. As other abstract entities, time instants exist tenselessly because they cannot change internal properties qua being abstract. Neither can they change relation to each other since their mutual structure is timelessly permanent.

### ***What makes an entity abstract?***

Concrete particulars such as objects exist in space and time, or at least in time, and their place therein constitutes their identity conditions. Often philosophers also point to the causal factor. Objects in space and time are able to interact with other objects and therefore have causal powers and liabilities. Space and time may not form the identity conditions of events, since two different physical events can occur at the same space-time point, but following Davidson's suggestion, having the same causes and the same effects may then provide the necessary identity conditions. So for concrete particulars such as physical events, which are in space and time, the same place in a certain chain of causation is what makes them identical. The last claim is, indeed, problematic because of the air of circularity, but for now I shall set this issue aside. Abstract particulars, however, are considered to be those particulars which do not share any of these identity conditions.

There seems to be several ways of understanding what it means to be an abstract entity. The diverse conceptions rely on the criterion which is used to pick out an entity as an abstract one. In the current philosophical debate the following suggestions occur:

- Abstract entities do not exist in space and time.
- Abstract entities are causally inert.

- Abstract entities are logically incapable of existing separate from other things.
- Abstract entities are those that are introduced as conceptual abstractions by the way of Frege's abstraction principle.

The first of these attempts to portray abstract entities sees them in direct opposition to concrete entities which are essentially characterized by having spatio-temporal properties. Things like numbers, sets, universals, and propositions, however, can also be ascribed properties although none of them have spatio-temporal attributes and therefore cannot be identified in terms of a space-time location. Nonetheless, such things can be said to exist as abstract entities because they are assumed to be indispensable for making statements about numbers, sets, universals, and propositions true.

Closely associated with the idea that abstract entities do not exist in space and time is the thought that they are incapable of having any causal influence on anything. It is, if not impossible, at least very difficult to imagine how something which does not exist in space and time could act upon something in space and time. Already in his own time, it was a main objection against Descartes' dualism how the mind, unextended in space, could causally act on the body which is spatially extended.

A further conception of abstract entities takes them to be incapable of existing independently of other things.<sup>2</sup> We may define a substance as a concrete particular whose existence does not depend for its existence on any other particular. It then follows, by contrast, that a particular whose existence is dependent on other particulars is an abstract entity in the sense under discussion. Indeed, it may be possible in thought to separate two particulars where one existentially depends on the other. An illustration of such a separation would be whenever we think of a particular colour (a trope) as being divided from the object which it is a colour of. Nevertheless, this view seems to exclude events from being concrete particulars since they exist inseparately from those things they involve. The emission of light cannot exist independently of the source which produces it. But events are concrete particulars to the extent that they exist in space and time, they also partake in causal explanations, and sometimes we even identify a concrete object in virtue of a certain event. A sudden flare on the sky, a supernova, may be used to identify the star that once has exploded. So an entity can be an abstract one in the sense of being existentially dependent upon other entities but still be pointed to as a concrete object in terms of having a location in space and time.

The fourth and final conception goes back to Frege. The idea is that abstract entities are abstracted from concepts following the Fregean abstraction principles. We sometimes refer to concrete objects by using functional expressions of the form ‘the *F* of *a*’. For instance, we say ‘The

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<sup>2</sup> See, for instance, Lowe (1998), Ch. 10.



capital of Canada,' or 'The quotation of Einstein in this paper'. Interesting enough, Ottawa might not have been picked as the capital of Canada; it might even today have belonged to France, England, or USA. It is not part of Ottawa's essence to be the capital of Canada. Similarly, this paper may have omitted any direct quotation, thus it is not part of the essence of the paper in question to have a quotation of Einstein. The claim is, however, that in those cases where the functional expression 'the  $F$  of  $a$ ' does not refer to any concrete object, say 'The direction of a line', then it is assumed to fulfil Frege's abstraction principle.

But how do we find out whether ' $F$ ' denotes an abstract sortal or not? In particular, how do we recognize, when saying 'The time of the attack on the Twin Tower in New York,' that the moment to which 'time' refers is an abstract existent?

Obviously, if  $F$  is existentially dependent upon  $a$ , what is needed is a criterion of identity that quantifies over a different kind of objects than over those of which it provides a criterion of identity; that is, it must quantify over objects of the same kind as  $a$  instead of objects of the same kinds as  $F$ . This is exactly what Frege's abstraction principle demands. The identity criterion for such cases can be stated in terms of a biconditional, where one side contains an expression of identity between such objects, which are referred to by means of a functional term relating them to items of the kind quantified over, and the other side contains an expression which ascribes a certain property to these items and states an equivalent relation connecting them. Therefore two

particular objects,  $a$  and  $b$ , are identical if their functional descriptions fulfil the following equation:

$$(A) \quad (x)(y)(f(x) = f(y) \text{ if, and only if, } G(x) \ \& \ G(y) \ \& \ yRx).$$

Thus, applying (A) on time instants, we get something like the following: the time instant of  $a$  is identical with the time instant of  $b$  if, and only if,  $a$  and  $b$  are events and they coexist. Moreover (A) can similarly be extended to space points as well if we replace events with objects and the relation of coincident.

Still we have to specify the features of  $R$  which is an equivalent relation. That feature of  $R$  does not suffice as the abstracting feature owing to the fact that functional expressions like ‘The capital of Canada’ and ‘The capital of the world’s second largest country,’ both selecting a concrete particular, fit the principle under discussion. We have namely that the capital of  $a$  is identical with the capital of  $b$  iff  $a$  and  $b$  are countries and  $a$  and  $b$  coincide.

Bob Hale proposes, however, that  $R$  should meet some further requirements. He argues that

$F$  is an abstract sortal iff, for any  $R$  that grounds  $F$ , either (i)  $R$  cannot hold between spatially located items at all or (ii)  $R$  can hold between things which are spatially, but not temporally, separated. (Hale 1987: 61).

The first proviso rests on the natural idea that  $R$  need not exist in space, since the objects over which we quantify can be abstract objects themselves. The second proviso says that in case the quantification runs over concrete objects,  $R$  cannot connect temporally separated items (because  $R$  would then not be symmetric). What is important then is how the grounding relation  $R$  attaches  $F$  with  $a$  while it excludes  $F$  from being a concrete sortal. Concerning  $R$ , Hale urges:

$R$  grounds  $F$  iff, for any statement of identity linking  $F$ -denoting terms, there is some statement to the effect that  $R$  holds among certain things, the truth of which is (logically) necessary and sufficient for the truth of that statement of  $F$ -identity (Hale 1987: 59).

This characterization of the grounding relation does not secure that (A) always picks out an abstract entity. This can easily be seen in case we substitute ‘The capital of Canada’ and ‘The capital of the world’s second largest country’ into (A). The truth of the right side is both logically necessary and sufficient for the truth of the left hand side.<sup>3</sup> Thus, it seems clear that an abstraction principle of such a simple form as (A) cannot function alone; it only provides a supplement of identity conditions to the conception according to which an abstract entity is existentially dependent and identity-dependent upon another entity.

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<sup>3</sup> See Burgess, J. & G. Rosen (1997) for further criticism. See also Lowe (1998: 52-53), where he argues that Hale’s proposal is fatally flawed.

The entity to which  $F$  refers is one whose existence strongly depends upon  $a$ , and therefore whose identity essentially depends upon  $a$ .<sup>4</sup> So using the abstraction principle (A), we do not get any further help in determining whether  $F$  denotes or does not denote an abstract unless we know this in advance: The nature of an entity whose essence it is to be  $F$  of  $a$  is an abstract. What we need to know in advance, it seems, is whether  $F$  is logically incapable of existing independently of  $a$ .

### ***Time and space as abstracts***

The rest of this paper will be dealing with the third sense of abstract mentioned above. An entity in this sense is an abstract if and only if its existence necessarily depends on other things. Such an identification of abstract objects is very different from a Platonist point of view according to which abstract entities such as ideas, concepts, numbers, etc. exist as objective real entities in their own right. But a Platonist has difficulties in explaining how we are able to access such a realm not existing in space and time, while it is causally inactive and may not be instantiated by any thing in the physical world. The non-Platonist does not have to give up a claim concerning the existence of abstract objects as far as he argues that their existence logically depends on the existence of things in space and time. Apparently we can grasp such objects through a process of abstraction.

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<sup>4</sup> See Lowe (1998: 215-16).

My suggestion is that time, but also space or space-time, is an abstract particular in all four senses. The reasons are that time cannot exist in time and space, time cannot causally interact with physical things, the existence of time depends on the existence of changing things, and temporal instances fulfil the abstraction principle. What interests us here is whether time can exist as a concrete particular independently of any physical things. Is it possible to have empty time or empty space-time? I think that the answer to this question is negative.

Assume that time consists of a continuous series of moments. Therefore if each moment is a concrete individual, it must fulfil definite identity conditions which show an instant of time to be concrete. But without the existence of physical events occupying these moments we cannot point to any inherent property which makes a specific moment to what it is and thereby separating it from other moments. The only way a moment can be separated from another moment is by their mutual position with respect to the entire series of moments. If this is so, it is quite obvious that shifting their mutual position would change their identity. But it seems to be a fundamental feature of concrete particulars that they do not change identity in virtue of their place in a structure. This is something which is only possible for abstract particulars such as numbers. The upshot is, if the argument is correct, that moments cannot be but abstract particulars.

Being an abstract particular, time cannot exist independently of the existence of changing things and events. The question is therefore what kind

of relationship we are confronting. The properties of time and space, as I said, supervene on properties of fields and matter in the sense that space and time cannot differ with respect to their properties unless the world itself also differ with respect to the properties of fields and matter. Yet, because space and time, or space-time, are existentially dependent on physical fields and matter, it is also the case that the properties of the latter may change without the properties of the former differ. In general, I believe that all abstract entities supervene on concrete particulars.

Thus, concrete particulars existentially determine abstract particulars, but in contrast to the supervenience relation, which holds between different levels of concrete objects, its determination cannot be of a causal or of a mereological nature. Instead, I maintain that the supervenience relation is grounded in instantiation and that abstract entities are those entities which are instantiated by concrete things and happenings. If my assertion is true, it means that space-time is instantiated by the gravitational field in accordance with the General Theory of Relativity.

Physical matter and energy do not determine space and time by having a direct causal influence on them, or on space-time, or vice versa. What is physical concrete and nomologically interdependent within the General Theory of Relativity are the gravitational fields on the one side and the matter fields on the other. The identification of the gravitational field with the metric of space-time is based on a stipulative definition and not an empirical

discovery.<sup>5</sup> Like all abstract particulars, space and time are causally inert whereas the gravitational field is not. It is merely our beliefs about space and time which may have an impact on the real world as well as our beliefs concerning the real world have an influence on our concept of space and time. Furthermore, space and time are not reducible to the mereological sum of concrete existents. The properties of space and time are irreducible to properties of physical things and physical occurrences.

There is an ongoing discussion among philosophers whether or not supervenience is sufficient for having reduction. There is no doubt that reduction requires that the properties of the reductive class supervenes on the subvenient basis. Jaegwon Kim and David Lewis argue, however, that the supervenience is sufficient for reduction; others have defended the anti-reductive view that it is not. In the first case, one can say that there is nothing over and above the subvenient basis, albeit the terms of the supervening class are semantically irreducible to the terms of the subvenient basis. In the second case, one may argue that the supervening class gives us an ontological surplus although not ontological autonomy in the sense that its existence is logically independent of the subvenient basis. When it comes to the discussion about abstract entities supervening on the concrete, I believe that it is impossible to have reduction because the abstract realm of entities, in contrast to the concrete realm, has neither spatio-temporal properties nor causal ones.

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<sup>5</sup> How this claim relates to the General Theory of Relativity, see Faye (2007)

Being abstract, space and time possess abstract properties, including modal properties, different from those of concrete particulars. Moreover, space-time is multiply realizable in the sense that the same metric structure may be instantiated by different physical worlds. For instance, time is a one dimensional continuum consisting of point instants ordered by tenseless relations such as 'later than', or the converse 'earlier than,' which supervene on the causal structure of the world. Space and time instants, as abstract particulars, exist as possible places or moments in which concrete things may take part. Although there are continuously extended particulars, such as fields, they are not abstract particulars because they carry, like other concrete individuals, momentum and energy and undergo disturbances. Space and time, or space-time, is determined by concrete existents in virtue of being the tenselessly ordered set of all happenings in the universe. Like other authors, I take a set to mean, not a collection of concrete entities, but a number of entities.

In contrast to the abstract, what counts as the concrete changes and moves around in space and time. Those changes may be characterized in terms of being either present, past or future. The formation of the solar system is in our past, whereas the destruction of the solar system is in our future. But I also think that these distinctions do not characterize events as such: Neither as inherent properties nor as modes of being. The special theory of relativity tells us that different events, if not causally connectible, vary between being past, present and future depending on the inertial observer.



We need concepts like time, space, or space-time, in order to be able to talk about any form of change and persistence of objects. These concepts give us the cognitive grounds for identifying and reidentifying things with respect to each other. We get hold on them through abstraction from the features of the empirical world.

### ***Is time invented or discovered?***

But what is the nature of abstract objects? If we characterize time as an abstract entity, which is abstracted from concrete happenings, it is still not clear what ontological status it has. Apparently, it is not completely objective or completely subjective. It is floating somewhere in between. Often we associate objectively existing phenomena with things which can be empirically discovered (if they are humanly accessible) and subjectively existing phenomena with things that are a result of human invention and construction. But this is not always the case. Kant's notion of space and time as transcendental forms of intuition was an idea which took space and time to be necessary a priori conditions of experience discovered by the pure reason. They do not form concepts which had been abstracted from observed things and their properties. Modern space-time physics, interpreted realistically, also takes space-time to be something which can be discovered. But this time it is a result of an empirical discovery based on the empirical support of relativity theories.

Other things may be a result of invention and still exist objectively. A car and a computer are humanly invented but exist as a physical thing independently of the car maker and the computer maker. But they only exist as cars and computers as long as we are along to assign a certain meaning to them in terms of their function. The same holds for languages, families, institutions, and states. Also they exist as concrete particulars in space and time. But they would not be here, had it not been for the human intervention. The difference is that physical objects like a car and a computer supervene on physical states of matter, whereas families, states, and the like, supervene on human beings and their communicative actions. On the other hand, pain may be said to be subjective and yet discovered by us as we feel pain. Introspection gives us empirical information about our own mental and cognitive states.

Thus, the question we have to address is whether or not space and time had existed if human beings did not exist. What I have said earlier was that space and time, as abstract particulars, supervene on concrete particulars, and therefore existentially depend on physical objects and physical happenings. This means that space and time would not have existed, had the physical world of stuff and fields not existed. Apparently, this indicates that space and time is discovered by us.

Another possibility is to say that the existence of space and time not only depends on the existence of concrete physical thing but also on the existence of human beings. We have formed a concept of space and time through abstraction, and this idea was indeed invented by us. The idea was

distracted from a collection of common features which we recognized to exist in concrete individuals. What corresponds to this idea is an abstract object. As long as we do not hold that the abstract entity is fully determined by the existence of the idea, but also by the existence of concrete individuals from which the idea is abstracted, abstract objects are not entirely subjective. In this case too, it seems reasonable to maintain that space and time are discovered by us although they would not have existed if it had not been for the discoverer. Space and time are epistemologically objective because we take them to supervene on concrete particulars.

I would say that reflection makes us discover space and time. Kant was right so far as it is by the reason that we find out the existence of space and time. As being abstracts, space and time are not discoverable by experience. But Kant was certainly not right when he argued that space and time exist prior to and independently of experience as proven by his transcendental methods. We can think of space and time, and the way we get to know their existence is through a rational abstraction from experience. We can think of space and time as supervening on concrete happenings because we have eventually formed a concept of them in order to explain the nature of concrete happenings. In addition, we can consider space and time to exist as abstracts because their existence is necessary for assigning truth value to descriptions that directly or indirectly refer to space and time. So space and time are neither transcendental nor physical real.

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