

IPP-SR-11: Presentism and relativity

James Read¹

¹Faculty of Philosophy, University of Oxford, UK, OX2 6GG

HT25

The course

1. Newton's laws
2. Galilean invariance
3. The Michelson-Morley experiment
4. Einstein's 1905 derivation of the Lorentz transformations
5. Spacetime structure
6. General covariance
7. Relativity and conventionality of simultaneity
8. Frame-dependent effects
9. The twin paradox
10. Dynamical and geometrical approaches to relativity
11. Presentism and relativity
12. Acceleration and redshift

Does only the present exist?

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How can this be possible, in light of the relativity of simultaneity?

Today

The metaphysics of time

Presentism and relativity

Presentist fallbacks

Presentism and cosmology

The growing block and relativity

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Static versus dynamical views

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- ▶ *Dynamic* views hold that temporal passage is fundamental.
- ▶ *Static* views deny this.

A-series and B-series

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- ▶ Those who believe in a 'moving present'—i.e., those who believe that temporal passage is fundamental—will be A-theorists.
- ▶ **Question:** Does the reverse of this implication hold?

The metaphysics of time

Which moments in time *really exist*?

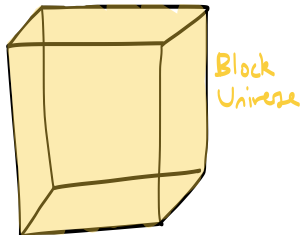
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There are three main views:

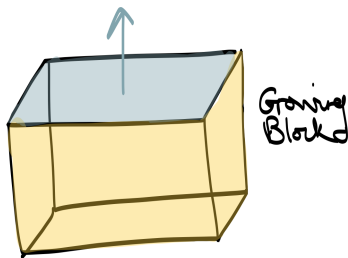
1. The block universe view
2. The growing block view
3. Presentism

The block universe



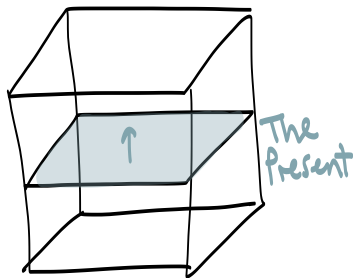
The *block universe view* (sometimes: *eternalism*) holds that past, present and future events are all equally real.

The growing block



- ▶ The *growing block view* holds that the past and present are real, but the future is not.
- ▶ Reality is four-dimensional, but the four dimensional block grows over time.

Presentism



According to *presentism*, reality is three-dimensional; the past and future are unreal.

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3. *Dynamic presentism*: Reality takes the form of a succession of instantaneous (or near-instantaneous) presents; no sooner has one present come into existence than it will depart from it, to be replaced by another.

Connections

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However, one should be wary of thinking that these connections are stronger than they are. They need not necessarily hold; for example,

- ▶ Solipsistic and many-worlds presentism are presentist static views.
- ▶ Eternalism (i.e. the block universe picture) is compatible with events having auxiliary, A-series properties. (See e.g. the 'moving spotlight view'.)

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- ▶ So there exists sufficient spacetime structure to identify the class of spacetime points which might qualify as ‘the present’.

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Special relativity

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- ▶ The relativity of simultaneity tells us that how we 'spread time through space' depends upon the frame from which the physics is described.
- ▶ The conventionality of simultaneity tells that, even within a frame, there's no fact of the matter about the simultaneity of spatially-separated events.

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4. Special relativity tells me that the events moving observers consider to be simultaneous will be different from those that I think are simultaneous.
5. Therefore, some events are real that are not simultaneous with me—so presentism is false!

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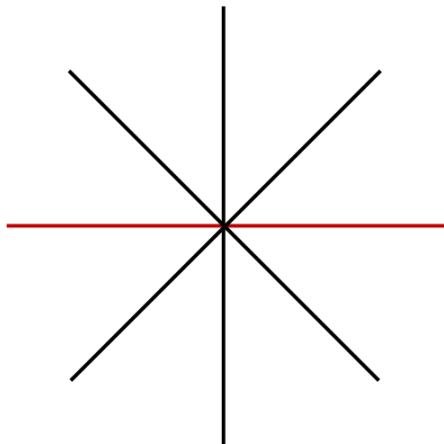
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3. Cone presentism

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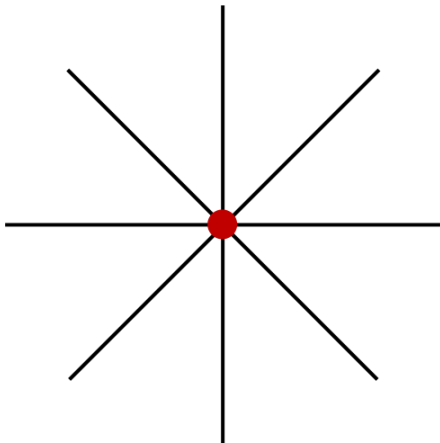
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Central concern: The extra, privileged simultaneity structure is otiose, and a throwback to Lorentz. (For more, see e.g. discussion of Lane Craig's *neo-Lorentzianism*.)

Point presentism



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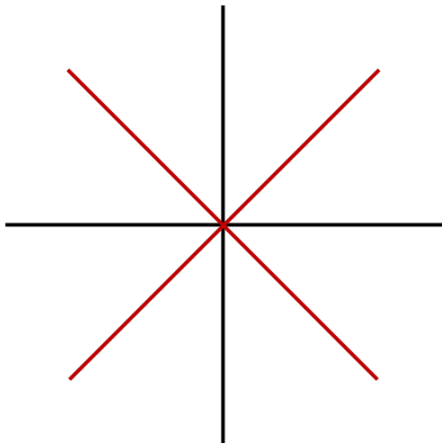
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2. *Whose* worldline? (Present as relativised to an observer?—But then why be a point presentist?)

Cone presentism



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One virtue of [cone presentism] is that it captures the idea that what is present is what I am seeing now. A second virtue is that it identifies the present with an invariant feature of the special theory. A third virtue is that we are not alone. (Hinchliff 2000, p. 580)

Two subviews

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The present is...

1. The 'past' lightcone? ('Backward-cone presentism')
2. The entire lightcone? ('Double-cone presentism')

Savitt on backward-cone presentism

[Backward-cone presentism] seems to rest on the idea that events on the past light cone of E have a lightlike separation from E and hence the spacetime interval from E to (say) E' (on the past light cone of E) is 0. But then it seems arbitrary to exclude from the present events on the future light cone of E , which are also light like separated from E . (Savitt 1998, p. 6)

Hinchliff's response

The surface of E 's past light cone is the set of events from which a light signal or ray could be sent to E . The surface of E 's future light cone is the set of events to which a light signal or ray could be sent from E . The difference between the cones is due to the asymmetry built into the nature of a light ray or signal. And that asymmetry arises from the asymmetric nature of causation itself, which is a non-arbitrary foundation on which to rest the distinction between cone and double-cone presentism. (Hinchliff 2000, p. 582)

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Is Hinchliff introducing extra structure in the form of a primitive causal relation here?

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- ▶ Radiation is currently reaching us from the cosmological decoupling period—does that mean we're simultaneous with the 'early' universe? (A worry for the double-cone presentist.)

Are we simultaneous with the 'early' universe?

To the extent that you find this objection compelling, you should be a presentist. The objection derives its force from the "fact" that CMBR originated 15 billion years ago. This "fact" comes from outside the special theory. The special theory is silent on the matter. Indeed, according to the special theory, there is no fact of the matter concerning how long ago this event happened. If we think it is a fact that this event happened 15 billion years ago, we must think there is a distinguished inertial frame which assigns events their "correct" dates. As a presentist, I say, "Great, the events that are simultaneous with me now in that frame are the existing events." If we think there is no distinguished inertial frame, then we cannot appeal to alleged facts like the radiation's originating 15 billion years ago in objecting to cone presentism. If there is a distinguished frame, we can stay good old-fashioned presentists. If not, we can be cone presentists. Either way, presentism is unscathed by objections of this sort. (Hinchliff 2000, p. 581)

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- ▶ Unlike the Minkowski metric, there is a preferred choice of temporal coordinate (i.e., foliation; i.e., frame) in which the FLRW metric simplifies.
- ▶ Thus, there *is* a preferred frame, once one moves to general relativity. This gives a notion of *cosmic simultaneity*.

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1. FLRW spacetime is an idealisation (it assumes perfect homogeneity and isotropy). The actual universe would be better represented by a ‘perturbed FLRW’ spacetime. Can cosmic simultaneity be defined in such spacetimes?
2. There are other solutions of general relativity in which the spacetime cannot be foliated into hypersurfaces *at all*—e.g., Gödel’s time travel solution. There are no good prospects for presentism there. But since metaphysics cannot be contingent (so the claim goes), there are no prospects for presentism in the actual world, either. (This is Gödel’s ‘modal argument’—see Gödel 1949.)

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These debates are ongoing. What we can say, though, is that there are (*prima facie*) serious problems for presentism in *special* relativity, which the proponent of the view must address.

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- ▶ How to define the hypersurfaces into which the block is growing in the relativistic context?
- ▶ (Further concern in general relativity: not all spacetimes are foliable into hypersurfaces—recall again the Gödel solution.)

The growing block and quantum gravity?

It might be that the growing block view finds a more natural home in certain approaches to *quantum gravity*...

Causal set theory

Think of the causal set as an idealized growing tree (in the botanical sense, not the combinatorial one). Such a tree grows at the tips of its many branches, and these sites of growth are independent of one another. Perhaps a cluster of two leaves springs up at the tip of one branch (event A) and at the same moment a single leaf unfolds itself at the tip of a second branch (event B). To a good approximation, the words “at the same moment” make sense for real trees, but we know that they are not strictly accurate, because events A and B occur at different locations and distant simultaneity lacks objective meaning. If the tree were broad enough and the growth fast enough, we really could not say whether event A preceded or followed event B. (Sorkin 2007, p. 4)

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5. Seen that while presentism might have better prospects in general relativity, the debates on this are ongoing.
6. Said something of the growing block view in the relativistic context.

Next time, we'll consider Einstein's transition from special relativity to general relativity.

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