Einstein's Train in Fragmentalist Presentism **9 19 2021**

Abstract

It is often thought the relativity of simultaneity is inconsistent with presentism. This would be troubling as it conflicts with common sense and—arguably—the empirical data. This note gives a novel fragmentalist-presentist theory that allows for the (non-trivial) relativity of simultaneity. A detailed account of the canonical moving train argument is considered. Alice, standing at the train station, forms her own ontological fragment, in which Bob's frame of reference, given by the moving train, is modified by the Lorentz transformations. On the other hand, Bob, in the train, forms his own ontological fragment from which Alice's space and time are modified by the corresponding Lorentz transformations. Each fragment accommodates a unique present moment but does *not* contain information about the unique present moment of another fragment. Reality is fragmented this way and —it will be argued—there are very good independent arguments for believing this to be the case. This allows for a 'universal' present moment that extends throughout space, but only from the perspective of each fragment. The relativity of simultaneity is, as it were, 'relativised' to each fragment. This is related to the idea, given elsewhere, that, roughly speaking, the time of relativity is McTaggart's (1908) B-series (earlier times to later times) and the time of quantum mechanics is a (fragmentalist) A-series (future/present/past).

1. Einstein's train thought experiment (Einstein 1905).

1.1 Suppose Alice is standing in the middle of the platform of a train station and lightning strikes each end of the platform simultaneously in her reference frame. She knows the strikes were simultaneous in her reference frame because after each strike a message is sent to her about when it happened.

1.2 Suppose Bob is standing in the middle of a train car that is the length of the platform in the rest frame of the car, and that the car is moving past the station.

1.3 The two lightning strikes will *not* be simultaneous in Bob's frame of reference.

1.4 It is often concluded that there is no ontologically privileged present moment, or no unique 'now', since if there were such a moment it would be simultaneous with itself (!), and therefore could not encompass both Alice's frame of reference and Bob's frame of reference.

1.5 We'll propose a flavor of presentism that is consistent with (1.1) – (1.3), looking at the train thought experiment in more detail. The basic idea will be that the Alice's system forms an ontological fragment that does indeed have a unique present moment that extends throughout all of space. Within her fragment Bob's (relatively moving) frame of reference is modified by the Lorentz transformations. But her fragment does *not* contain the information of Bob's unique present moment. And *vice versa*. There is just no fact of the matter about both present moments taken together.

One thing to note at this stage is that this idea may at first seem *ad hoc*, but I'll argue it is anything but.

2. McTaggart's A-series and B-series characterize 1 dimension of time.

2.1 McTaggart (1908) identified two different series that characterize time. There is the B-series and the A-series.

> "Positions in time, as time appears to us *prima facie*, are distinguished in two ways. Each position is Earlier than some, and Later than some, of the other positions. And each position is either Past, Present, or Future. The distinctions of the former class are permanent, while those of the latter are not. If M is ever earlier [for time-like separated events] than N, it is always earlier. But an event, which is now present, was future and will be past."

I will not follow McTaggart to the conclusion that time is unreal, but suggest that time is real and 1 dimension of time has both B-series and A-series characteristics, as most A-theorists posit.

I would argue, as many A-theorists do, the A-series, as not reducible to the B-series in any way, is also a part of a comprehensive view of time. The A-series consists in the 'ontologically privledged' *present* and *becoming*.

2.2 In this theory of time, instead of supposing

2.2.1 'time goes from past to present to future'

as is often done, it would be more appropriate to suppose

2.2.2 'time goes from earlier times to later times as it becomes from future to present to past'

As later and later times become present, time goes on.

2.3 The idea will be to add to each system an A-series that is 'ontologically private' to that system, while retaining the ontologically public (but relativized) B-series interrelations. These are 'private' now's, so, presumably, the *apparent* 'universal now' that contains even every quantum system results from some kind of averaging over the more-or-less ubiquitous private nows.

3. Fragmentalism

3.1 There are several notions of "Fragmental" physics in use. In (2005) Fine introduced the notion of fragmentalism. The idea was that reality is divided up into fragments. One way to put this is to say that in one fragment there is no fact of the matter about the value of a parameter in another fragment. What is true in one fragment need not be true in another fragment. Reality is 'divided up' into various fragments in some ontological sense.

In Fine's original fragmentalism, it is supposed that different relativistic frames of reference form different fragments, so that what is true in the frame of reference of one relative velocity is not necessarily true in a rest frame. This is too extreme a notion for this paper.

3.2 Another notion of fragmentalism is to apply it to quantum mechanics in the following sense. If Schrodinger's Cat is in the state

3.2.1 [psi> = [alive> + [dead>

then each of the basis vectors [alive> and [dead> form two different fragments (Simon 2018). This is problematic, as (Iaquinto et al. 2020) argues. It cannot be that each vector forms a fragment, since in the fragment of the reference system the state of the cat is the *one* vector [psi>, given by the sum of the two basis vectors taken together.

3.3 The notion of fragmentalism in this paper is that each quantum system (no matter how small/simple/non-local (which is to say non-local within the spacetime of a given fragment)) forms a fragment. And that is because each quantum system has it's own A-series. For the A-series parameters there will be no fact of the matter as to their joint values in more than 1 fragment.

4. The train thought experiment reconsidered.

4.1 Alice stands at the train station in the middle of the platform, ready for the experiment to commence. She is 'always' in her ontologically privileged present moment. *This is empirically given data.* Suppose the train car containing Bob (who is of course at rest relative to the train car) moves past the platform.

Many pairs of events that are simultaneous in Alice's frame of reference will *not* be simultaneous in Bob's frame of reference. Indeed the space and time of Bob's frame of reference are modified by the Lorentz transformations from the perspective of Alice.

4.2 So far, there is no contradiction, because we've only talked about Alice's present moment (given by her A-series), her clock-times (given by her B-series), and the clock times in Bob's frame of reference (given by his B-series).

4.3 The idea is then that Alice's A-series defines her ontological fragment. The contradiction comes in only if we add the postulate that Bob has a unique present moment *in Alice's fragment*. But this postulate is easily (and perhaps necessarily, see section (6)) avoided if we suppose that Bob's A-series delineates his own fragment—one that is distinct from Alice's fragment—and is one in which there is no information about Alice's unique present moment.

Alice's fragment contains the information of Alice's A-series, Alice's B-series, and Bob's B-series. But Alice's fragment does *not* contain the information of Bob's A-series, and *vice versa*. As they pertain to two different fragments, there is explicitly no 'simultaneous' fact of the matter about both Alice's A-series (and therefore her present moment and her 'becoming') and Bob's A-series (and therefore his present moment and his 'becoming').

In Alice's fragment, Bob's B-series is modified by Lorentz transformations. And in Bob's fragment, Alice's B-series is modified by the corresponding Lorentz transformations.

4.4 In this way, a present moment that extends throughout space is relativised (so to speak) to each fragment, and no contradiction ever arises.

4.5 This concludes the Fragmentalist Presentist account of the Einstein's train thought experiment. But it would be best to make a few germane comments.

5. On experimental outcomes.

An experimental outcome is revealed to Alice *only* in her present moment (her ‘now’). She can theorize all she wants but she cannot *demonstrate* an outcome to me that is in our future (nor past). Thus an account of the A-series is required in scientific accounts of experiments that aim to be complete. The exploration and further defense of this principle lies outside the aim of this note.

6. This proposal is the opposite of *ad hoc*. To the extent it may be accepted, section (5) gives one argument, and this section gives another one.

6.1 Each of two people’s subjective phenomenal states are not accessible to the other person. (I cannot determine if your green is qualitatively the same as my green when we both look at a pile of leaves—a pile that elicits what we would each call ‘green’ qualia). And *vice versa*. Reality is fragmented in this way.

6.2 This applies to all quantum systems (each of which forms a fragment) no matter how simple/small/non-local, given panpsychism (Goff et al., 2020).

6.3 The A-series is phenomenal (see, for example, Farr 2019).

6.4 Hence the A-series in each fragment is not accessible by another fragment. Thus, no specific ‘temporal value’ can be given to the present of another fragment. The information is just not there.

7. The robustness of this interpretation.

7.1 If our physical theories were to radically change tomorrow, such as the computational formalism of quantum mechanics, then the other realist interpretations on the table (e.g. Many-worlds, GRW, Pilot-wave, Transactional, Consistent histories) might have to radically change their philosophical tenets or even be abandoned altogether.

7.2 That is not true of this interpretation. If our physical theories were to radically change tomorrow, it would still be true that subjective phenomenal states are inaccessible to each other and that the A-series is arguably phenomenal.

The evidence for this is *pre-theoretical* and therefore cannot be wrong in the sense that only a (secondary) theory/concept *about* these phenomena could be wrong.

7.3 It could be said that this interpretation is not only realist but *super-realist* in that the data used is more certain than even that there are objects ‘out there’ independent of our minds or that there are physical laws.

7.4 This interpretation has the virtue of incorporating both the A-series and the B-series, which is arguably more plausible than a theory of physics that uses only a B-series.

8. Finally,

8.1 Clearly there is a great deal more to say (Merriam 2021). But the aim of this note was to only focus on the train/station thought experiment because that is one of the stem arguments showing the relativity of simultaneity and the (erroneous) conclusion that presentism is untenable.

8.2 One interesting feature of this interpretation is that the enlarged 'presentist spacetime' is, within each fragment, described by *five* parameters (namely, an A-series parameter τ, a B-series parameter t, and the three space parameters x^a) and not *four* parameters (namely, a B-series parameter t, and the three space parameters x^a) as in the case of Minkowsi space. I have argued elsewhere this is a significant virtue.

One can define a (sometimes variable) rate $r = - dt/d\tau$ in well-defined units, for each fragment, and this leads to a generalization of the Lorentz transformations.

8.3 At the risk of oversimplification, the slogan here might be that the time of quantum mechanics is a (fragmentalist) A-series, and the time of relativity is a B-series, with the understanding that these two temporal series are not entirely independent. But, again, the intention of this note was to focus on only the train/station thought experiment.

9. References

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