Albert Einstein, my Imperfect Intellectual Idol

By Tim Moon

Abstract

Current and widespread political unrest is leading to a critical reappraisal of the records of some of our celebrated historical figures. Even our own personal idols and heroes may prove to have had unexpected human weaknesses. Intellectually speaking, my lifelong idol is Albert Einstein. But recently, I've discovered he too displayed a significant flaw in intellectual terms. This essay explains how I found that his celebrated thought experiment about a train hit by lightning — the one which demonstrated we're all deceived if we think the passage of time we call 'now' is simply a universal and objective fact — was itself highly deceptive. I show how his apparently scientific argument was actually specious. Not only that, it then becomes apparent that his famous postulates of Special Relativity really lead to a very different conclusion. I doubt very much that Einstein consciously intended to mislead us. Nevertheless he did, and what you might call a blot in an otherwise brilliant theoretical career should be recognised. Not in order to denigrate his huge contribution to science, but to put straight our record of the proper scientific inference from this particular thought experiment. The proper conclusion is that simultaneity is conserved when changing perspective.

We live in times when statues of famous and hitherto celebrated people have been torn down. In different parts of the world, it seems a new awareness is being forced on us. Some are realising for the first time that many of their erstwhile heroes also harboured human flaws — personal imperfections they were blind to, or may even have conspired to actively deny. Sometimes these flaws have taken the form of very deep prejudices, having effects on others which were evidently long lasting and widely damaging. More commonly, their human imperfections will have been much less socially consequential. Nonetheless, we have to come to terms with the fact that very surprising contradictions can exist in human nature, even for our idols and heroes. If necessary, it seems we should all be prepared to assess their record in a more open-minded and enlightened way — by embracing a critical recognition of their more negative side, where due.

Had I been able to afford a statue for my garden, I'd have chosen a widely recognised genius from physics and philosophy, Albert Einstein. All my adult life he's stood as my intellectual idol. As a young man I’d readily appreciated his fabulous legacy of independent and creative thought. I saw and admired how it led us to an enriched view of our whole universe. It’s only quite recently I’ve come to see clearly that he also had a distinct intellectual flaw. It took me a while to understand something which is much less commonly recognised — that in one significant intellectual respect, he misled us, really quite badly.

The uncomfortable truth I’ve had to face is that Einstein’s celebrated and popularly targeted argument for the relativity of simultaneity was highly deceptive. On critical examination it looks almost as if it was designed to mislead. For the imaginary situation he described, its effect was to draw a veil over the fact that his Special Relativity postulates are actually consistent with exactly the opposite conclusion to the one he confidently asserted. In reality, the illustrative device he chose actually leads to the conclusion that simultaneity is not relative, but is clearly conserved when changing perspective.

I aim to communicate my current understanding of this issue in a scientifically accurate but non-specialist and non-mathematical way. To this end I have to start this critique with a rather formal restatement of the two famous postulates on which Einstein’s Special Theory is founded.

The first postulate simply embraces the classical principle of relativity. This recognises that no matter what inertial frame of reference you physically occupy, all the laws of physics will seem to you to operate in just the same normal way. The second postulate is in effect a predicted consequence of combining this principle with James Clerk Maxwell’s very successful theory of the electromagnetic propagation of light: it states that the speed of light, when measured in any frame of reference, will always be found to stay at precisely the same standard speed, irrespective of any motion in the source of the light.

During the early construction phase of his new theory, Einstein was all too aware that there was an unacceptable contradiction between what his second postulate said and the results of applying the classical protocol for transforming velocities between relatively moving reference frames. This protocol had long been established in accordance with the classic relativity principle provided by Galilei Galileo — and subsequently endorsed by Issac Newton. This principle is a firm aspect of classical mechanics; the simple transformation procedures associated with it are known within physics as the Galilean transformations.

Einstein illustrated his early concern with this fundamental contradiction (Einstein, 1920, pp. 21-24) with a simple and commonsensical example: if a ray of light is overtaking a rapidly moving train, the classical Galilean result is that relative to the train, the speed of the light ray must now measure as very slightly diminished. It will be decreased by an amount in exact accordance with the speed of the train. Yet Einstein's proposed postulates were saying that when measuring the speed of light from such a position, even a very small diminution cannot happen. He acknowledged there appeared to be a problem for the veracity of his proposed theoretical approach: it was evident there was a direct conflict between his new light postulate and the old but respected principle of relativity (given this was the basis of the Galilean transformations). Yet somehow, he wished to retain this combination, teaming up the relativity principle consistently with his new light postulate.

Einstein found a very bold solution to this troubling conflict. It is exactly this problem that he resolved in such an astonishingly groundbreaking way with his Special Theory of Relativity. He asks us to let go of our natural preconceptions about the fixed nature both of distances in space and the passage of time, and thus see that the conflict of his light postulate with the old idea of relativity is actually not such a problem after all. His solution involved keeping the old relativity principle, but replacing the Galilean transformation protocol. He substituted it with a new and more universally applicable procedure; one he'd adapted from the then recent work of Lorentz. In the light of this new transformation process — which allowed time and lengths to fundamentally vary in association with relative motion — his light postulate was shown actually to be entirely consistent with the classical principle of relativity. This new transformation procedure was particularly germane in the case of objects in very rapid motion, especially those starting to approach the speed of light. So the old mechanical protocol inherited from Galileo, despite retaining its everyday veracity (it's usually a close enough approximation in practical terms) could now be seen as misleading in terms of fundamental variations in space and time. This limitation was especially evident in the case of the relative motion of objects travelling at anything like the phenomenal speed of light.

More than a decade after publishing the paper which first unveiled his Special Relativity theory, Einstein employed an imaginary device — dubbed a ‘thought experiment’ — to persuade all of us just why, along with him, we should take the bold step of abandoning our natural view of time. His aim was to get us all to accept his firm conviction that the universal passing moment of time we call ‘now’ is actually illusory. He wanted to convince ordinary non-technical readers that what we judge as happening simultaneously depends entirely on physical perspective. Therefore, it cannot reflect an objectively fixed property of our universe. In short, his purpose was to prove the relativity of simultaneity to us in a way anyone might readily grasp.

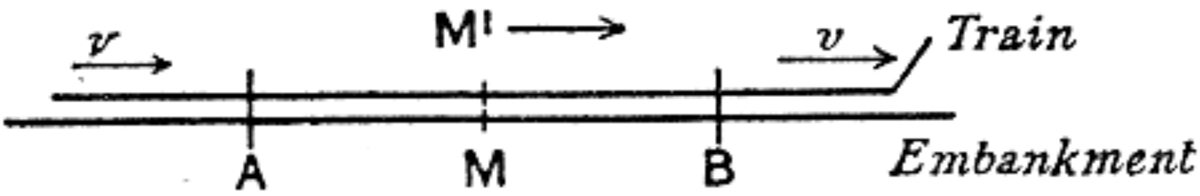

Fig. 1

Einstein’s famous ‘train and lightning’ argument is expressed very briefly and is easy to read — and it’s readily accessible on the internet, just as he published it exactly a century ago (Einstein, 1920, pp. 30-32). I will try to summarise it even further; the diagram (Fig.1) is simply a copy of the one he provided.

In a nutshell, first we’re asked to imagine there’s a train cruising along relative to its stationary track, on an embankment. Then, two lightning strikes happen simultaneously, one right at each end of the train. The strike positioned at the rear of the moving train is labelled as A, the one at the front as B. The resulting flashes each radiate as a beam of light along both the embankment and the train; the beam from A travelling in the same direction as the train, the beam from B, in the opposite direction.

An observer positioned at M, halfway between where strikes A and B happen in the stationary embankment perspective, will experience the beams of light converging at that position at the same speed, and therefore see them arriving at the same time. Thus this observer must judge the strikes to have occurred simultaneously. However, for the observer who is at position M1 halfway along the train and who is moving along with it, things aren’t quite so straightforward.

Considering things from the stationary viewpoint, Einstein predicts a different judgement will be made by this moving train-based observer (a male). Referring to him, Einstein says:

Now in reality (considered with reference to the railway embankment) he is hastening towards the beam of light coming from B, whilst he is riding on ahead of the beam of light coming from A. Hence the observer will see the beam of light emitted from B earlier than he will see that emitted from A. Observers who take the railway train as their reference-body must therefore come to the conclusion that the lightning flash B took place earlier than the lightning flash A.

In this statement, Einstein has cleverly succeeded in expressing the main substance of his argument in a remarkably pithy and very commonsensical way. However, it's necessary to carefully 'unpack' his statement a little, to reveal the rather complex logic it actually conveys.

What Einstein's succinct description is saying is that from the point of view the embankment viewer — for whom both beams of light are assumed to be travelling at the same constant speed — it can be predicted that the train observer is being hit by the beam coming from position B on the embankment earlier than the beam coming from position A. This is because the train observer's movement away from position A towards position B has shortened the distance beam B has to travel to reach him. Conversely, his movement has lengthened the distance beam A has to travel to reach him. Therefore, the train observer will see beam B arriving before beam A. For this reason he will conclude that strikes A and B couldn't have occurred simultaneously: B happened before A.

This logic of the situation as predicted from the embankment perspective seems pretty cast iron — providing we assume three types of quantity as objectively fixed: (i) the speed of the light beams along the embankment (ii) the scale of distances involved in both frames, and (iii) the rate of the passage of time in both frames. Then it seems the conclusion must be that the judgement of simultaneity is relative to perspective.

Of course, using the same assumptions, we should turn to look at the logic of the situation seen directly from the point of view of the train observer himself. Einstein's succinct statement seemed to conspicuously neglect any direct description corresponding to this obviously relevant step. Instead, it relies on predictions made from the embankment perspective.

Even so, what Einstein's succinct predictions mean for the train observer is that from his position halfway along the train, the embankment speed of the beam coming from strike B will be seen to be augmented ("he is hastening towards the beam of light coming from B"), by an amount in accordance with the forward speed of the train; i.e. the embankment light speed and train speed must be added to obtain the light speed relative to him. Conversely, the speed of the beam coming from strike A will be seen as diminished ("he is riding on ahead of the beam of light coming from A"), also by an amount in accordance with the forward speed of the train; i.e. the train's speed must be subtracted from the embankment speed of the light beam to obtain the speed relative to him. Thus, because of the differing speeds of the two light beams as they converge on his midway position in the train, he will see the more rapid beam arriving from B first — a short time before the slower beam arrives from A. So from his point of view, he must conclude that strike B happened before strike A.

Once again, the logic of the situation predicted for the train observer's perspective seems very cast iron. Exactly the same conclusion as before is clearly warranted: the judgement of simultaneity is relative to perspective. So bang goes any fond preconceptions we might have had about a universal and objective 'now'!

But hang on a moment. Nothing here is as truly cast iron as at first it may have seemed. Stop and reflect carefully on Einstein's predictions about the train observer's experience and judgements. You'll recognise he's chosen not to base them on his own postulates, nor on the Lorentzian procedure he favoured. Instead, he's based them entirely on the old Galilean protocol for transforming velocities between reference frames — the very procedure his new theory was designed to supersede.

What on earth possessed him to do that? Remember his earlier example about a light beam overtaking a train? How he stressed the unacceptable contradiction with his postulates the classical protocol provided? Suddenly, he now seems to think otherwise — he's chosen *not* to regard this protocol as even the slightest bit incompatible with his views. Indeed, he's based his argument solely on accepting the results of directly applying the old mechanical procedure, taking it entirely at face value. And in so doing, he's assuming the fixed nature of distances in space and the absolute nature of the passage of time — both theses qualities being central to the classical rationale.

As a consequence, he's ended up suggesting the train observer must be experiencing the speed of each of the flashes of light to be altered from their standard speed, even if only very slightly. I can only assume we weren't meant to notice that this prediction is once again in direct opposition to his own light postulate. You will recall this says that the speed of light, when measured with respect to any reference frame (such as the train) must always remain at exactly a standard value. It cannot appear as augmented or diminished from such a perspective, even very slightly.

In fact, had the man sitting halfway down the train experienced both flashes as travelling at exactly the same standard speed, in proper accordance with both of Einstein's postulates, then the flashes wouldn't have been seen as occurring one after the other, but as simultaneous. For a very detailed description confirming the logic of this situation, see Moon, 2020, pp. 4-10. Meanwhile, I'll try to summarise that description here.

Firstly, it can be readily agreed that the predicted conclusion from the embankment observer, judging the strikes to be simultaneous, is perfectly sound. It's entirely consistent with the notion that this observer must see both beams of light travelling at exactly the same constant speed, just as Einstein's postulates decree. But now, let's turn directly to considering the train observer's experience. The postulates decree that he too must experience both the light beams as arriving from each end of the train at the same constant speed. This being so, when the beams traversing the length of his train converge at his midway position, he'll see them arriving together. Consequently, he too will judge them to have originated from flashes which occurred simultaneously at each end of his train.

So now, Einstein's postulates — in the absence of any necessity to rely on transformations between frames — are showing us that the same flashes of light must equally be seen as simultaneous from the two differing perspectives. Simultaneity isn't relative after all! The same passing 'now' is conserved in both locations.

However, maybe we were tacitly assuming distances and time to have the same fixed nature for both observers — just as Einstein certainly did when predicting different judgements about the simultaneity of the strikes. To avoid such assumptions, we could consider doing exactly what

Einstein's original thought experiment clearly didn't even try to do. We could imagine applying his theory of Special Relativity to the imaginary train situation. In other words, we could consider how things would turn out if again, both postulates are applied — but this time also including the Lorentzian transformations (in place of the classical Galilean approach). Application of the mathematically more complex Lorentzian protocol would show the length of the train to be contracted when considered from the embankment frame; similarly, the passage of time on the train would be dilated compared with the embankment.

Of course, in the case of any real-life version of the train and lightning scenario, the changes thus predicted in the train's length and passage of time (as considered from the embankment perspective) would be so excessively tiny as to be completely indiscernible in any practical sense. Although not zero, they would be truly negligible, given the slow speed of any real train. Nevertheless, drawing once again on the magic of the thought experiment method, we can still consider the implications of these minute changes, if only in principle. Briefly reverting once more to the familiar lightning-strike scenario, let's again focus on the observer's experience on the train. This time, we'll be considering it in the light of applying the Special Theory of Relativity.

As each of the light beams pass along the train observer's moving train carriage from each end, we now know the train is predicted to have its length contracted and its time dilated (from the point of view of the embankment observer). However, the train observer himself wouldn't perceive anything as changed: it's important to appreciate this would still be the case, even were the changes large enough to be perceived. It's actually the theory which says that from his perspective, all would continue to appear as normal.

Now, suppose the observer managed to measure the speed of the light beams from his position, halfway along the train. What would he find? According to the theory he must measure both light beams as travelling at exactly the same standard speed. In that case, the analysis I provided earlier would still clearly apply. The moving train observer would still judge the lightning strikes as simultaneous, just like the stationary embankment observer.

Once again, simultaneity would have been conserved — despite the prediction from Special Relativity of a differing measure of lengths and a differing passage of time between the two observers.

If you'd already read Einstein's thought experiment about the relativity of simultaneity a while ago, and thought — like so very many before you — that Einstein's argument was good, then I'm afraid you were simply deceived. Whether you (and a legion of others, over the years) were intentionally deceived, or whether it was due to some sort of motivated but unwitting aberration of thinking on Einstein's part, of course I cannot say with absolute certainty. However, I think it's extremely unlikely that it was simply a knowing and intentional deception. But either way, the unvarnished truth is if you went along with his train, you were taken for a ride.

My critique has been restricted entirely to questioning the rationale and conclusions of just a single thought experiment put forward by Einstein — albeit one that is of special significance in metaphysical terms and which relates to a keystone concept in his whole theoretical edifice. Whether the recognition of a reversal to the normally accepted conclusions for his thought experiment might have any deeper implication — say for Einstein's theories themselves, or for our understanding of the nature of time — is an entirely different and unanswered question.

For me, the only thing my critique clearly implies is that I should regard my hero Albert Einstein as a distinctly imperfect intellectual idol. Personally, I've no real problem in coming to terms with this somewhat negative insight. But I think it's something that should also be broadly recognised. The fact is, despite Einstein's generally positive and huge contribution to scientific and philosophical knowledge, in the single matter we've considered he was guilty of deploying a devious and covert rationalisation. Presumably this was motivated strongly by an obsessional desire to see a broad acceptance of his own deeply rooted metaphysical conviction.

That may sound an unnecessarily hostile thing to want to say about such a great historical figure. Especially given his deceptive ploy is hardly likely to have been intentional. I believe it was almost certainly self-deceptive in origin. But my essay is not about trying to denigrate our memory of Einstein. It's about the fact that there's a particular scientific wrong to put right. I believe no one having respect for the values of science should conspire to ignore or dogmatically deny such criticisms, if they are due. Or if they are long overdue, as in this case. Over a whole century, only a very few writers (see Moon, 2020) have criticised Einstein's demonstration of the relativity of simultaneity in anything like similar terms — and even then, it seems no one took enough notice.

References/bibliography

Einstein, A. (1920) *Relativity: The Special and General Theory.* Available at https://ibiblio.org/ebooks/Einstein/Einstein_Relativity.pdf

Moon, T. (2020) *After a Century of Revolution in the Status of Space: Einstein's Train Revisited.* Available at https://vixra.org/abs/2007.0104