

## **Example of Subtext of Relativity**

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The ambiguous way that Einstein has presented his relativity theory has meant that various pro-relativists have interpreted things differently. So, we should be aware of when reading a pro- relativity writer that there is the subtext – that they are only presenting their personal beliefs and not the beliefs of the whole relativity community. As an example I look at the pro-relativity writings of John G Cramer.

The article which I will analyse and use as an example of the subtext in relativity texts is the article “The Twin Paradox of Relativity” by John G Cramer. [1] Cramer is a Professor of Physics at the University of Washington. [2].

Cramer states in 1990 states: “The twin paradox is still, some 85 years after publication of Einstein's paper on special relativity, not generally understood.”

The subtext here is that a great deal has been written on the Twin Paradox and there is not general agreement on its resolution.

He states two arguments which he calls the “symmetry argument” and the “know nothing argument” and then he states: “Both of these arguments are wrong.”

The subtext here is that he presenting his opinion of relativity (and hence his version of relativity) and claiming the other versions which you might read are wrong.

The general pattern is that -- we have various people setting themselves up as authority on relativity and claiming their versions of relativity is correct. Einstein created this situation by not really explaining his theory clearly; that opened the floodgates to various people interpreting his theory in different ways.

It is this ambiguity in Einstein’s relativity that makes it very difficult to convincingly attack, because it is not clearly defined, its supporters can modify it to treat their purposes. And when it comes to these relativity supporters they need not be agreeing on the same theory; and instead they have freedom to believe different things. So when it comes to Einstein’s relativity it is really a collection of different theories; which are of course loosely connected by common themes. The ambiguity that has led to this freedom to believe different things has been a large part of the appeal of Einstein for these people; because when there is disagreement in their relativity community, they can then take the view that they know best over others in the relativity community.

So when we look at Cramer we need to bear in mind that it is only his opinion on relativity theory and not the opinion of every supporter of relativity; same as when we look at any relativity advocate – it is not the opinion of all the relativists.

Cramer gives the symmetry argument as:

"An observer Ernest who remains behind and at rest will observe that astronaut Sam on board the ship travels away at a speed  $v$  and then returns at the same speed. But Sam also observes that the stay-at-home observer Ernest travels away from **him** at speed  $v$  and then returns at that speed. Sam is just as good an observer as Ernest, and since each observes the other having the same velocity relative to himself, there can be no difference in the readings of Ernest's clock and Sam's clock when the two clocks are compared at the end of the trip."

And he gives the know-nothing argument as:

"The Lorentz transformations of special relativity only apply to objects travelling with constant speeds. But space ships must accelerate and decelerate in their operation. From the equivalence principle of general relativity we know that acceleration is equivalent to the effects of gravity and that gravity must be handled with the elaborate mathematical machinery of general relativity. Therefore, the twin paradox cannot be analyzed with special relativity alone, and we can't simply use the Lorentz transformations to say what the two clock readings will be after the trip. If there **is** any difference in the clock readings, it arises strictly from general relativity effects."

Now we have already mentioned that he believes these two arguments are wrong. I shall critically analyse his reasoning against the first argument:

He says: "The Lorentz transformations of special relativity on which the twin paradox is based assume that the set of observations of mass, length, and time is made from one *inertial reference frame*, one coordinate system that is either at rest or is moving with an unchanging speed in a particular direction. Clearly, observations do not have to be made from an inertial reference frame, but if they are not, the Lorentz transformations don't directly apply."

This is fairly reasonable, when SR (special relativity) texts deal with Lorentz transformations and their range of applicability only to inertial frames not non-inertial frames, they seem to be implying that SR only deals with inertial frames.

He continues: "The significance of this is that the system of observer Ernest is an inertial frame, while the system of observer Sam is *not* an inertial frame. Sam is not in an inertial frame because in mid trip his ship's engines were used to accelerate him and to reverse the direction of his velocity for the return leg of the trip."

Various texts on SR have pointed out similar for the Twin Paradox, and sometimes point out that the solution of Twin Paradox is not contained within SR because non-inertial frame is involved with SR dealing only with inertial frames. Alternatively they say about SR dealing only with constant velocity not acceleration. If Cramer were following these other texts he would be saying that the Twin Paradox was not solved in SR. Anyway he continues:

"If one constructs *world lines* for the two observers by plotting space position against time position on a piece of graph paper, the world line of Ernest is straight, an indication that he is in an inertial frame. The world line of Sam, however, has a kink

at the place where the ship's acceleration takes place, an indication Sam is *not* in an inertial frame.”

Various texts then talk about such a kink in the space-time diagram caused by acceleration as then making the scenario as GR (general relativity) not SR.

Cramer continues:

“Therefore, the seeming "symmetry" between systems Ernest and Sam is illusory. Their observations are not equivalent because Ernest observes from an inertial frame while Sam does not.”

Cramer then analyses the situation from an acceleration frame, he thinks this solves the problem. But the real issue is whether the Twin Paradox can be solved within the context of SR, and some texts say no. Those texts which say no think that SR deals only with constant velocity not acceleration. So the real issue is whether Cramer when he moves to dealing with acceleration is this still in the context of SR. Cramer seems to be under the impression that it's still SR when there is acceleration.

There are thus two types of interpretation of SR theory:

- (1) SR only deals with constant velocity
- (2) SR deals with acceleration

Cramer seems to interpret SR as (2), but other texts interpret as (1).

He has not then really addressed the issue. He has not provided reasoning as to why his interpretation (2) is correct over interpretation (1). Instead he has just pretended from authority that his interpretation is correct, and if you don't interpret it his way then you are wrong.

In reasoning against the second argument he makes it clear that he believes interpretation (2), he says:

“The "know-nothing" argument is wrong because its basic premise is incorrect. The formalism of general relativity is *not* required to deal with acceleration.”

He now makes clear that he believes interpretation (2). He continues from that belief as:

“Special relativity works fine for accelerating objects, as long as the Lorentz transformations are based in a reference frame that is *not* accelerating. One simply allows object's velocity to change with time. You can think of the process as breaking up the acceleration into little time intervals during which the velocity has a certain average value, and then apply the value of gamma appropriate to that velocity in that time interval. This may require some calculus, but it doesn't require general relativity, which deals with the effects of gravity fields.”

So he is saying contrary to some relativity texts that SR can deal with acceleration.

But is that really SR; when SR is modified to deal with acceleration in the way he says is that really still SR – that issue he does not address.

And now he says GR deals with gravity, presumably meaning that SR does not.

One of the main transitions from SR to GR is that GR adds the Equivalence Principle, and that is an extra assumption where inertial acceleration can be assumed equivalent to gravitational acceleration. The issue then here is – if SR does not have the Equivalence Principle, and deals with acceleration then it is only treating that acceleration as inertial, can such a theory which does not fully treat acceleration properly be a proper theory of acceleration—he does not address that issue either.

He continues:

“However, general relativity does provide us with another way of thinking about the twin paradox. According to general relativity, a clock runs slower in a gravitational potential  $V$  by a factor of  $(1-V/c^2)$ . This means that a clock on the surface of the Earth runs slower than an identical clock in gravity free space...”

He then considers an absurd thought-experiment where gravity can be switched on and off for the whole observable universe – we will omit that. He does seem to believe that this switching gravity on and off is the GR case, and thinks that GR case is equivalent where GR could treat the Twin Paradox..

He says: “It's comforting, but not particularly surprising, to find that special and general relativity give the same answer for the twin paradox. The conclusion is that Sam, the twin who feels the force pushing him against the floor, ages less than his twin Ernest, who can remain in free fall or zero-g the whole time. So when you feel the pull of gravity on your aging bones and muscles, consider that because of it you're aging less.. “ [but only by small effect]

An extra issue Cramer has not considered is that in the way SR is usually presented (in the articles he believes wrong) SR only deals with inertial frames so that all the frames are treated the same; which is no asymmetry; the observers are symmetric-what one observer observes as the laws of physics, so does the other observer. This symmetry is the whole point of relativity principle in SR. Now when he introduces acceleration he has the twins ageing at different rates; not as per the SR scenario of symmetric ageing. In other words he has introduced a preferred frame. But from the SR scenario there is not supposed to be this preferred frame. The preferred frame idea of course leads us back to the experiments of Michelson- Morley when they were trying to measure this preferred frame of the ether and failed; SR was supposed to answer that question as the symmetry of relativity. Now Cramer re-introduces preferred frame. i.e. has modified SR on that issue.

## **Conclusion**

Cramer has not really addressed any of the issues; he has only highlighted what he believes. He believes SR is interpretation (2) and deals with acceleration. But the real issue is- how has SR been defined, is it defined as per interpretation (1) or (2). Einstein seems to have been unclear on this issue (like many others), so he left it to

others who came after him to interpret. Some interpret one way and others interpret other ways. Cramer interprets his way and if anyone decides to interpret other ways, he thinks them wrong. The whole subject of relativity becomes one of ambiguity on numerous issues like this – when if we modify SR does it stop being SR; we can modify SR a bit more and bit more until it looks like GR, but when the theory is in transition is it still really SR, or some other theory. It is this morphing of relativity theory that allows it to be a hybrid beast, subject to different interpretations and not a definite theory.

### **References**

- [1] The Twin Paradox Revisited, John G. Cramer, Published in the March-1990 issue of Analog Science Fiction & Fact Magazine  
<http://www.npl.washington.edu/AV/altvw38.html>
- [2] <http://faculty.washington.edu/jcramer/faculty.html>