SPECIAL RELATIVITY: PART TWO

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Abstract

According to Einstein's Special Theory of Relativity, the speed of light always remains constant at 186,000 miles per second regardless of whether it is gauged from a stationary reference point, a moving reference point or any other reference points, no object could travel faster than 186,000 miles per second (the speed of light itself) because the mass of the object would then be so great (infinitely great) that it could not accelerate anymore, on approaching the speed of light a moving object contracts in length in the direction of motion while a clock gauging the time slows down, at the speed of light the length of the moving object contracts to zero while the clock (and time) becomes at a standstill, and, importantly, the mass of an object multiplied by the square of the speed of light gives energy ($E = MC^2$), i.e., mass could be converted to energy and vice versa; on approaching the speed of light the brain and bodily functions of a person slow down; observers do not agree on the simultaneity of events - two simultaneous events for one observer might not be simultaneous for another; in the Special Theory time-travel (in the space-time continuum) is an apparent possibility. A deeper look at the Special Theory of Relativity is presented in this paper, employing some strong, subtle and important mathematical reasoning in the process.

Relativity And The Speed Of Light

The Special Theory of Relativity posits that on approaching the speed of light clocks slow down, moving objects contract in length in the direction of motion, and, a person's brain and bodily functions slow down. For example, a person on a moving vehicle (moving frame), which travels besides a beam of light (moving frame) in the same direction and almost as fast as the beam of light (moving frame) itself, gauges the speed of the beam of light (moving frame). The Special Theory postulates that this person on the moving vehicle (moving frame) traveling at almost the speed of the beam of light (moving frame) would find the speed of the beam of light (moving frame) to be unchanged at 186,000 miles per second, instead of the difference between the speed of the moving vehicle (moving frame) and the speed of the beam of light (moving frame), which would normally be the case; this is because, according to the Special Theory, on the moving vehicle (moving frame) approaching the speed of light the clock therein used to gauge the time traveled by the beam of light (moving frame) has slowed down by the same degree (say X %) as the ruler or measuring device therein used to gauge the distance traveled by the beam of light (moving frame) has contracted in length in the direction of the vehicle's motion (also X %), the greater the moving vehicle's traveling speed the more the clock slows down and the greater the length contraction of the ruler or measuring device. This is expressed in the following equation, which is in accordance with the Special Theory of Relativity:-

(186,000 miles - X % of 186,000 miles) ÷ (1 second - X % of 1 second) = 186,000 miles per second

A person traveling at almost the speed of light (as in the case of the person in the above-mentioned vehicle traveling at almost the speed of light (moving frame) besides a beam of light (moving frame)) would experience the slowing down of time and age more slowly (without being aware of it), as stipulated by the Special Theory of Relativity. This "time dilation" effect is described by the following equation:-

$$t = \frac{t'}{\sqrt{1 - v^2/c^2}}$$

t = time gauged by a clock at the ground level (stationary frame); t' = time gauged by a clock on the above-mentioned vehicle traveling at almost the speed of light (moving frame); c = speed of light = 186,000 miles per second; v = speed of the above-mentioned vehicle traveling at almost the speed of light (moving frame), e.g., 0.9c; t' would be a fraction of t, i.e., $t' < t$, e.g., if t' = 24 years, v = 0.8c, then t = 40 years.

But (and this is a very important "but"), if the moving vehicle's clock had not slowed down and its ruler or measuring device had not contracted in length (i.e., under normal conditions), the speed of the light beam (moving frame), as gauged from the vehicle traveling besides it at almost the speed of light (moving frame), would have had been the difference between the speed of the light beam (moving frame) and the speed of the moving vehicle (moving frame), e.g., 186,000 miles per second (speed of the light beam) minus 185,990 miles per second (speed of the moving vehicle), which is equal to 10 miles per second.

Thus, the speed of the light beam (moving frame), i.e., 186,000 miles per second, as gauged from the vehicle traveling besides it at almost the same speed (moving frame) in the same direction is evidently an *illusion*, which is the result of the slowing down of the clock, and, the brain and bodily functions of the person, on the moving vehicle (moving frame), and the contraction in the length of the ruler or measuring device (in the direction of motion) therein, as stipulated by the Special Theory of Relativity. This is somewhat similar to the situation whereby a driver in a car which is actually cruising at 60 miles per hour believes that his car is traveling at 30 miles per hour because the car's speedometer, which happens to be faulty, gives a reading of the car's cruising speed as 30 miles per hour instead of 60 miles per hour, i.e., the driver is misled by the car's faulty speedometer.

In the above-mentioned case, the person on the vehicle traveling at almost the speed of light (moving frame), say a space-ship, would not notice that his clock is ticking more slowly, time is passing more slowly for him, he is aging more slowly and the length of the ruler or measuring device on his space-ship (moving frame) has contracted in the direction of motion (because there is nothing to compare with). According to the Special Theory of Relativity, when this traveler on the space-ship traveling at almost the speed of light (moving frame) looks at a clock on Earth (stationary frame) he would perceive that the clock has slowed down and when he looks at a ruler or measuring device on Earth (stationary frame) he would perceive that it is shorter. But, this is evidently only an illusion and not true, and, the clock ticking away on Earth (stationary frame) is actually ticking more quickly (which implies that time is passing more quickly) as compared to the traveler's clock on the space-ship traveling at almost the speed of light (moving frame) and the ruler or measuring device on Earth (stationary frame) is actually longer as compared to the traveler's ruler or measuring device on the space-ship traveling at almost the speed of light (moving frame) - according to the Special Theory of Relativity, the clock on the space-ship traveling at almost the speed of light (moving frame) has slowed down and both the length of the space-ship traveling at almost the speed of light (moving frame) and the length of the ruler or measuring device on this space-ship (moving frame) have contracted in length in the direction of motion, whilst the clock on Earth (stationary frame) has not slowed down and the ruler or measuring device on Earth (stationary frame) has not contracted in length.

According to the Special Theory of Relativity, the person on Earth (stationary frame) who takes a peep at the clock on the space-ship traveling at almost the speed of light (moving frame) would perceive that the clock ticks more slowly than his clock on Earth (stationary frame). He would also perceive that the ruler or measuring device on the space-ship traveling at almost the speed of light (moving frame) is shorter than his ruler or measuring device on Earth (stationary frame), and, that the space-ship is foreshortened in the direction of its motion. The person on Earth (stationary frame), according to the Special Theory, would see the clock on the space-ship traveling at almost the speed of light (moving frame) slowed down to the same degree as the traveler on the space-ship traveling at almost the speed of light (moving frame) sees the clock on Earth (stationary frame) slowed down and see the length of the ruler or measuring device on the space-ship traveling at almost the speed of light (moving frame), as well as the space-ship's length, shortened to the same degree as the traveler on the space-ship traveling at almost the speed of light (moving frame) sees the ruler or measuring device on Earth (stationary frame) shortened. That is, each of the them, the person on Earth (stationary frame) and the traveler on the space-ship traveling at almost the speed of light (moving frame), according to the Special Theory, would measure the above-mentioned differences in the other to the same degree, and, the other thing each of them would agree on is the constancy of the speed of light (the speed of light would remain constant at 186,000 miles per second).

But, actually, on Earth (stationary frame), the clock has not slowed down and time passes more quickly, and, the length of the ruler or measuring device has not contracted, whereas on the space-ship traveling at almost the speed of light (moving frame) the reverse, as described above, is true. The dilemma is which time is to be regarded as the actual or correct time - the time on Earth (stationary frame) or the time on the space-ship traveling at almost the speed of light (moving frame) - and, which length is to be regarded as the actual or correct length - the length of the ruler or measuring device on Earth (stationary frame) or the length of the ruler or measuring device on the space-ship traveling at almost the speed of light (moving frame)?

According to Einstein, time is relative, i.e., there is no such thing as absolute or actual time, which is a Newtonian concept; Einstein had done away with Newton's concept of absolute time and space. Time depends on the speed of the clock, and, the brain and bodily functions - the nearer the speed of light is approached the slower would be the clock and the passage of time, as well as the brain and bodily functions. What does all this imply? Without a clock, and, consciousness it would not be possible to tell the time - time would not exist, i.e., the reality of time is not independent of the clock, and, consciousness. In fact, without the clock, or, watch everyone would be disoriented where the time is concerned.

However, like the case of the car driver misled by his car's faulty speedometer which is described above, the traveler on the space-ship traveling at almost the speed of light (moving frame) described above has also been misled into thinking that his clock is ticking normally and his time is passing normally, and, his ruler or measuring device is normal and gauging lengths or distances normally. It is only after taking a peep at the clock ticking away and the ruler or measuring device on Earth (stationary frame) that he would realize this might not be so. After having taken a peep at the clock ticking away and the ruler or measuring device on Earth (stationary frame) and perceiving that the clock on Earth (stationary frame) is ticking more slowly and the ruler or measuring device there is shorter (which is in accordance with the Special Theory of Relativity), he should suspect that either his clock on his space-ship traveling at almost the speed of light (moving frame) or the clock on Earth (stationary frame), and, either his ruler or measuring device on his space-ship (moving frame) or the ruler or measuring device on Earth (stationary frame) are not quite right. If he finds out that in fact his clock on his space-ship traveling at almost the speed of light (moving frame) has been ticking more slowly, time has been passing more slowly for him, he has been aging more slowly and the length of the ruler or measuring device on his space-ship traveling at almost the speed of light (moving frame) has contracted in the direction of his space-ship's motion, due to some change in the physical environment, viz., the presence of an intense gravitational field which is created through travel at almost the speed of light, he would realize that the accuracy of the time presented by his clock on his space-ship traveling at almost the speed of light (moving frame), as well as the length or distance measurements made by the ruler or measuring device on his space-ship (moving frame), are out. He would then think that perhaps the time presented by the clock ticking away on Earth (stationary frame) and the length or distance measurements made by the ruler or measuring device there are the actual or correct time and length or distance measurements. But, he might not be able to find out that his clock has been ticking more slowly, time has been passing more slowly for him, he has been aging more slowly and the length of the ruler or measuring device on his space-ship traveling at almost the speed of light (moving frame) has contracted, due to some change in the physical environment, viz., the presence of an intense gravitational field, and, even if he found out that the clock on Earth (stationary frame) is actually ticking more quickly than his and the ruler or measuring device there has actually not contracted in length and is actually longer than his (which is in accordance with the Special Theory of Relativity) he might not understand why and might be puzzled as to whether his clock and ruler or measuring device on his space-ship traveling at almost the speed of light (moving frame) or the clock and ruler or measuring device on Earth (stationary frame) are the clock and ruler or measuring device which are faulty (assuming he has no knowledge of the Special Theory of Relativity).

If neither of the two parties (on Earth (stationary frame) and on the space-ship traveling at almost the speed of light (moving frame)) had been aware that their respective clocks had been ticking away at different speeds, and, the lengths of their respective rulers or measuring devices had been different, then each of them would have regarded the times shown by their respective clocks as the actual time and the lengths displayed by their respective rulers or measuring devices as the actual length, in which case there would be two sets of actual time and actual length, i.e., two sets of reality, a quite absurd situation.

As the third party looking on at the two cases described above and being aware of the circumstances, we could regard the time presented by the clock on Earth (stationary frame) as the actual or correct time and the time presented by the clock on the space-ship traveling at almost the speed of light (moving frame) as the distorted time. Also, as the third party who is all too familiar with the Special Theory of Relativity we could regard the length of the ruler or measuring device on Earth (stationary frame) as the actuality and the length of the ruler or measuring device on the space-ship traveling at almost the speed of light (moving frame), which has contracted in the direction of the space-ship's motion, as the distorted length.

We here consider the example of two space-ships traveling almost next to one another in the same direction, one (we call it X, which is a moving frame) traveling at almost the speed of light, say, 185,000 miles per second (as gauged from Earth, a stationary frame) and the other (we call it Y, which is another moving frame) traveling also at almost the speed of light, say, 185,500 miles per second (as gauged from Earth, a stationary frame). (Theoretically, no space-ship could travel at the speed of light - the Special Theory of Relativity stipulates that at the speed of light everything would be at a standstill - the mass of the space-ship would be infinite and the space-ship would not be able to accelerate anymore, the space-ship's length would have shrunk to zero and any clock within the space-ship would have stopped beating, registering zero time.) The speed of Y (moving frame) as gauged from X (moving frame) or vice versa is computed by using the following formula, as is stipulated by the Special Theory of Relativity:-

$$v = \frac{b - a}{1 - ba/c^2}$$

where c = speed of light = 186,000 miles per second, b = speed of Y = 185,500 miles per second (= 0.9973118c), a = speed of X = 185,000 miles per second (= 0.9946236c)

$$\therefore v = \frac{0.9973118c - 0.9946236c}{1 - 0.9973118c \times 0.9946236c/c^2}$$

$$= \frac{0.0026882c}{1 - 0.9919498c^2/c^2}$$

$$= \frac{0.0026882c}{0.0080502}$$

$$= 0.3339295c \text{ (33.39295 \% of speed of light)}$$

$$= 0.3339295 \times 186{,}000 \text{ miles per second}$$

$$= 62{,}110.887 \text{ miles per second}$$

∴ speed of Y as gauged from X = plus 62,110.887 miles per second (and not plus 500 miles per second (185,500 miles per second minus 185,000 miles per second), which should normally be the case - Y (moving frame) should appear to the traveler in X (moving frame) to be moving away from X (moving frame) in the same direction)

∴ speed of X as gauged from Y = minus 62,110.887 miles per second (and not minus 500 miles per second (minus (185,500 miles per second minus 185,000 miles per second)), which should normally be the case - X (moving frame) should appear to the traveler in Y (moving frame) to be moving away from Y (moving frame) in the opposite direction)

What would be X's and Y's respective speeds then (when gauged from the other), when X (moving frame) and Y (moving frame) travel in opposite directions (instead of the same direction)? The speed of Y (moving frame) as gauged from X (moving frame) and the speed of X (moving frame) as gauged from Y (moving frame) should each not exceed 186,000 miles per second, the speed of light, which represents the ultimate limit, the maximum possible speed any accelerating object could attain, as is stipulated by the Special Theory of Relativity (and not respectively 370,500 miles per second (185,000 miles per second plus 185,500 miles per second), which should normally be the case), and, they are computed by using the following formula (which is described further on), which is in accordance with the Special Theory of Relativity:-

$$v = \frac{a + b}{1 + ab/c^2}$$

where c = speed of light = 186,000 miles per second, a = speed of X = 185,000 miles per second (= 0.9946236c), b = speed of Y = 185,500 miles per second (= 0.9973118c)

$$\therefore v = \frac{0.9946236c + 0.9973118c}{1 + 0.9946236c \times 0.9973118c/c^2}$$

$$= \frac{1.9919354c}{1 + 0.9919498c^2/c^2}$$

$$= \frac{1.9919354c}{1.9919498}$$

$$= 0.9999927c \text{ (99.99927 \% of speed of light)}$$

$$= 0.9999927 \times 186{,}000 \text{ miles per second}$$

$$= 185{,}998.64 \text{ miles per second}$$

∴ speed of Y as gauged from X = speed of X as gauged from Y = 185,998.64 miles per second (Y (moving frame) should appear to the traveler in X (moving frame) to be moving towards X (moving frame) in the opposite direction, and, X (moving frame) should appear to the traveler in Y (moving frame) to be moving towards Y (moving frame) in the opposite direction)

How strange and counter-intuitive it is to find the speeds of X (moving frame) and Y (moving frame) to be minus 62,110.887 miles per second and plus 62,110.887 miles per second respectively as gauged from Y (moving frame) and X (moving frame) respectively (and not minus 500 miles per second and plus 500 miles per second respectively, which should normally be the case) in the first case above, and, to be each only 185,998.64 miles per second (less than the speed of light (186,000 miles per second) and not respectively 370,500 miles per second (185,000 miles per second plus 185,500 miles per second), which should normally be the case) in the second case above, one may think. Evidently, the respective clocks in X (moving frame) and Y (moving frame) were slowing down at different speeds and the respective rulers or measuring devices in X (moving frame) and Y (moving frame) were contracting in length to different extents, since the respective speeds of X (moving frame) and Y (moving frame) are different, viz., 185,000 miles per second and 185,500 miles per second respectively (the higher the speed of the space-ship the more its clock would slow down and the more the length of its ruler or measuring device would contract). As stipulated by the Special Theory of Relativity, both the travelers in X (moving frame) and Y (moving frame) would each see the other’s clock as being slower to the same degree and the other’s ruler or measuring device as being shorter to the same degree. The dilemma here is to decide whether the clock on X (moving frame) or the clock on Y (moving frame) is giving the correct reading in time and whether the ruler or measuring device on X (moving frame) or the ruler or measuring device on Y (moving frame) is providing the correct measurement in the distance traveled/measured. It is evidently very difficult to decide thus. The travelers in X (moving frame) and Y (moving frame) would each naturally think that everything is fine and consider their respective gauging of the other’s speed as correct (assuming that they have no knowledge at all about the Special Theory of Relativity). However, if the travelers in X (moving frame) and Y (moving frame) noticed that the other’s clock had been slower and the other’s ruler or measuring devices had been shorter, they might each be puzzled and might each wonder whether whose clock and ruler or measuring device are accurate (assuming that they have no knowledge of the Special Theory of Relativity). Of course, if they had known the principles behind the Special Theory of Relativity they would have realized that this phenomenon had been the result of “distortion” due to the creation of an intense gravitational field through travel at almost the speed of light, i.e., the slowing down of their respective clocks and the contraction in the lengths of their respective rulers or measuring devices are transient (they are not permanent - X's and Y's respective clocks would beat at the normal rate and the lengths of their respective rulers or measuring devices would return to their original length once the speeds of X (moving frame) and Y (moving frame) have returned from almost the speed of light (185,000 miles per second and 185,500 miles per second respectively) to the normal speeds, according to the Special Theory of Relativity).

The important question is if the space-ships', X's and Y's, times and length or distance measurements are "distorted" or not real, what should be the real time and real length or distance measurement? However, to both the travelers in space-ships X (moving frame) and Y (moving frame), without being able to compare or look at one another's clock and ruler or measuring device and without any knowledge of the Special Theory of Relativity, the time given by their respective clock and the length or distance measurement given by their respective ruler or measuring device would be the *real* time and *real* length or distance measurement. But, to us, the third party looking on at these two scenarios, who have knowledge of the Special Theory of Relativity, both X's and Y's "real" times and "real" length or distance measurements are illusions and are indeed not real, and, the real time and real length or distance measurement would be those read off a clock and a ruler or measuring device on Earth (stationary frame), where the clock and the ruler or measuring device are free from the "distortional" effect of the intense gravitational field created through travel at almost the speed of light. Since to the traveler on space-ship X (moving frame), the traveler on space-ship Y (moving frame) and to us on Earth (stationary frame), our times and length or distance measurements are "real" to each of us, it is implied that time and length or distance measurement are relative, i.e., time and length or distance measurement depend on environmental or situational factors.

All this appears to be a case of how we choose to interpret these three scenarios. For example, if we put ourselves in the X traveler's shoes, have no knowledge that Y (moving frame) exists or if we know that Y (moving frame) exists we have no knowledge that Y's clock is running at a different pace and that Y's ruler or measuring device is gauging length or distance differently from our ruler or measuring device, and, have no knowledge that our clock has slowed down and that our ruler or measuring device has shrunk in length, i.e., we have no knowledge of the Special Theory of Relativity, then we would just think that our time and length or distance measurement in X (moving frame) are the real things. The same applies if we put ourselves in the Y traveler's shoes. On the other hand, if the person concerned were wised up to the Special Theory of Relativity he could choose to regard the real time and real length or distance measurement as those only made by any clock and any ruler or measuring device on Mother Earth (stationary frame). This is only one possible interpretation. A philosophical-minded person could choose the other interpretation, viz., X's time and length or distance measurement are real to the traveler in X (moving frame), Y's time and length or distance measurement are real to the traveler in Y (moving frame), and, Earth's time and length or distance measurement are real to the resident on Earth (stationary frame), i.e., there are different realities. Should there be only one reality or should more than one reality be allowed?

Therefore, consciousness or knowledge of certain facts, e.g., the fact that there is another clock under a different set of circumstances ticking away at a different speed, as described above, or, simply some other clock to compare the time with would affect our sense of time, time being the fourth dimension in Einstein's Relativity theory.

Also, a person could be deceived about the time by a faulty clock, a case which is similar to the above-mentioned case of the car driver being misled by the faulty speedometer of his car.

All this implies that time is subjective, or, as Einstein had put it, relative (not absolute), depending on the situation, and, consciousness has an important role to play.

There should be a sufficient reason to explain why the clock, and, the brain and bodily functions of the person slow down, and the length of the ruler or measuring device contracts, on approaching the speed of light, while at the speed of light the mechanism of the clock and time are at a standstill and the length of the ruler or measuring device is zero, which is important. Though the intense gravitational field caused by travel at almost the speed of light might account for the slowing down of the clock (for which experimental evidence had been obtained) and therefore time, as well as the brain and bodily functions of a person, it evidently hardly suffices as an explanation for the contraction of the length of the ruler or measuring device in the direction of travel at almost the speed of light (for which experimental evidence has yet to be found, and, which seems like a "fudge on the figure" by the inventor of the theory to "ensure the constancy of the speed of light"). Though the constancy of the speed of light as gauged from the Earth is evidently a well-proven phenomenon, no one has yet been able to travel at almost the speed of light and gauge the speed of a light beam by traveling besides it in the same direction, as described above - despite the experimental findings that at high speeds, though very much less than the speed of light, clocks slow down, the contraction of rulers or measuring devices in the direction of motion at almost the speed of light is evidently only an inference, with no experimental basis.

The following equation describes how the speed of light (v) is derived:-

$$v = d/t,$$

where d represents the distance traveled by the light beam and t represents the time taken by the light beam to travel the distance d

Since time is relative (and not absolute) and depends on the mechanism of the clock, as well as consciousness, which slow down on approaching the speed of light, it could be arbitrary. The clock which is used to gauge the time t taken by the light beam to travel the distance d might not slow down uniformly (at the same rate) on approaching the speed of light (under normal, earthly conditions time varies from clock to clock by minutes or more - there is evidently some uncertainty in the mechanism of clocks). Besides, the ruler or measuring device used to gauge the distance d traveled by the light beam in time t might not contract in length uniformly (at the same rate) on approaching the speed of light. If the clock does not slow down uniformly (at the same rate) and the ruler or measuring device does not contract in length uniformly (at the same rate) on approaching the speed of light there is all probability that the speed of light (v) as represented by d/t would be variable, higher than 186,000 miles per second at times, below 186,000 miles per second at other times, or, equal to 186,000 miles per second at yet other times. Moreover, in accordance with the Special Theory of Relativity, as described above, for the speed of light to really remain constant, on approaching the speed of light the clock must slow down to the same degree as the contraction in the length of the ruler or measuring device. (This explanation presented by the Special Theory of Relativity is incorrect.) We describe these possible outcomes as follows. (Only for argument’s sake here, we assume that the above statement “for the speed of light to really remain constant, on approaching the speed of light the clock must slow down to the same degree as the contraction in the length of the ruler or measuring device” is correct and would lead to the following possible outcomes; the examples which follow, for the sake of argument, would also be based on this assumption.):-

i) $S^{\%} > C^{\%} \rightarrow I^{l}$
ii) $S^{\%} < C^{\%} \rightarrow D^{l}$
iii) $S^{\%} = C^{\%} \rightarrow S^{l}$

where $S^{\%}$ represents percentage of slowing down of the clock, $C^{\%}$ represents percentage of contraction in the length of the ruler or measuring device, I^{l} represents increase in the speed of light, i.e., exceed 186,000 miles per second, D^{l} represents decrease in the speed of light, i.e., go below 186,000 miles per second, S^{l} represents speed of light, i.e., 186,000 miles per second

We ponder this point more deeply by reconsidering the two examples pertaining to space-ships X (moving frame) and Y (moving frame) which have been described above.

Let us look at the first case pertaining to space-ships X (moving frame) and Y (moving frame) traveling at speeds of 185,000 miles per second (as gauged from Earth, a stationary frame) and 185,500 miles per second (as gauged from Earth, a stationary frame) respectively in the same direction almost next to one another. The speed of Y (moving frame) as gauged from X (moving frame) should normally be plus 500 miles per second (185,500 miles per second minus 185,000 miles per second) and the speed of X (moving frame) as gauged from Y (moving frame) should normally be minus 500 miles per second (minus (185,500 miles per second minus 185,000 miles per second)), as explained above. But, the speed of Y (moving frame) as gauged from X (moving frame) and the speed of X (moving frame) as gauged from Y (moving frame) should be plus 62,110.887 miles per second and minus 62,110.887 miles per second respectively, as computed by using the formula below, which is in accordance with the Special Theory of Relativity:-

$$v = \frac{b - a}{1 - ba/c^2}$$

where c = speed of light = 186,000 miles per second, b = speed of Y = 185,500 miles per second (= 0.9973118c), a = speed of X = 185,000 miles per second (= 0.9946236c)

$$= 62{,}110.887 \text{ miles per second}$$

speed of Y as gauged from X = plus 62,110.887 miles per second (and not plus 500 miles per second (185,500 miles per second minus 185,000 miles per second), which should normally be the case - Y (moving frame) should appear to the traveler in X (moving frame) to be moving away from X (moving frame) in the same direction)

speed of X as gauged from Y = minus 62,110.887 miles per second (and not minus 500 miles per second (minus (185,500 miles per second minus 185,000 miles per second)), which should normally be the case - X (moving frame) should appear to the traveler in Y (moving frame) to be moving away from Y (moving frame) in the opposite direction)

Evidently, the clocks and rulers or measuring devices on X (moving frame) and Y (moving frame) have respectively slowed down and contracted in length in the direction of motion to different degrees while X (moving frame) and Y (moving frame) have been traveling at 185,000 miles per second and 185,500 miles per second respectively, almost the speed of light. Whilst the respective speeds of Y (moving frame) and X (moving frame) as gauged from the other should be plus 500 miles per second and minus 500 miles per second respectively, the slowing down of their respective clocks and the contraction in the lengths of their respective rulers or measuring devices to different degrees have resulted in the above-mentioned plus/minus 500 miles per second being gauged differently, as shown in the following examples:-

For example, if the length of the ruler or measuring device on the space-ship contracts by 20 % while the space-ship travels at almost the speed of light, the relative speed of plus/minus 500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of plus/minus 62,110.887 miles per second, which is in accordance with the Special Theory of Relativity:

$\frac{\text{62,110.887 miles}}{\text{1 second}}$ = 400 miles (0.8 of 500 miles - due to ruler length contraction of **20 %**, 500 miles are gauged by space-ship traveler as 400 miles) ÷ 0.00644 second (due to clock on space-ship slowing down by **15528 %**, 1 second is gauged by space-ship traveler as 0.00644 second)

For example, if the length of the ruler or measuring device on the space-ship contracts by 40 % while the space-ship travels at almost the speed of light, the relative speed of plus/minus 500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of plus/minus 62,110.887 miles per second, which is in accordance with the Special Theory of Relativity:

62,110.887 miles / 1 second = 300 miles (0.6 of 500 miles - due to ruler length contraction of **40 %**, 500 miles are gauged by space-ship traveler as 300 miles) ÷ 0.00483 second (due to clock on space-ship slowing down by **20703.93 %**, 1 second is gauged by space-ship traveler as 0.00483 second)

For example, if the length of the ruler or measuring device on the space-ship contracts by 60 % while the space-ship travels at almost the speed of light, the relative speed of plus/minus 500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of plus/minus 62,110.887 miles per second, which is in accordance with the Special Theory of Relativity:

62,110.887 miles / 1 second = 200 miles (0.4 of 500 miles - due to ruler length contraction of **60 %**, 500 miles are gauged by space-ship traveler as 200 miles) ÷ 0.00322 second (due to clock on space-ship slowing down by **31055.9 %**, 1 second is gauged by space-ship traveler as 0.00322 second)

However, if the length of the ruler or measuring device on the space-ship contracts by, e.g., 20 %, and the clock on the space-ship slows down by the same percentage, i.e., 20 %, while the space-ship travels at almost the speed of light, the relative speed of plus/minus 500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), would remain the same, i.e., plus/minus 500 miles per second, which is in accordance with the Special Theory of Relativity:

500 miles / 1 second = 400 miles (0.8 of 500 miles - due to ruler length contraction of **20 %, 5**00 miles are gauged by space-ship traveler as 400 miles) ÷ 0.8 second (due to clock on space-ship slowing down by **20 %**, 1 second is gauged by space-ship traveler as 0.8 second)

We now look at the second case pertaining to space-ships X (moving frame) and Y (moving frame) traveling at speeds of 185,000 miles per second (as gauged from Earth, a stationary frame) and 185,500 miles per second (as gauged from Earth, a stationary frame) respectively in opposite directions. The speed of Y (moving frame) as gauged from X (moving frame) and the speed of X (moving frame) as gauged from Y (moving frame) should each normally be 370,500 miles per second (185,000 miles per second plus 185,500 miles per second), as explained above. However, the speed of Y (moving frame) as gauged from X (moving frame) and the speed of X (moving frame) as gauged from Y (moving frame) should each not exceed 186,000 miles per second, the speed of light, which represents the ultimate limit, the maximum possible speed any accelerating object could attain, as stipulated by the Special Theory of Relativity (and not respectively 370,500 miles per second (185,000 miles per second plus 185,500 miles per second)), which should normally be the case), and, they are computed by using the following formula, which is in accordance with the Special Theory of Relativity:-

$$v = \frac{a + b}{1 + ab/c^2}$$

where c = speed of light = 186,000 miles per second, a = speed of X = 185,000 miles per second (= 0.9946236c), b = speed of Y = 185,500 miles per second (= 0.9973118c)

$$= 185{,}998.64 \text{ miles per second}$$

speed of Y as gauged from X = speed of X as gauged from Y = 185,998.64 miles per second (Y (moving frame) should appear to the traveler in X (moving frame) to be moving towards X (moving frame) in the opposite direction, and, X (moving frame) should appear to the traveler in Y (moving frame) to be moving towards Y (moving frame) in the opposite direction)

Let us look at the following examples:-

For example, if the length of the ruler or measuring device on the space-ship contracts by 60 % while the space-ship travels at almost the speed of light, the relative speed of 370,500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of 185,998.64 miles per second, which is in accordance with the Special Theory of Relativity:

185,998.64 miles = 148,200 miles (0.4 of 370,500 miles - due to ruler
1 second length contraction of **60 %**, 370,500 miles are gauged by space-ship traveler as 148,200 miles) ÷ 0.79678 second (due to clock on space-ship slowing down by **125.51 %**, 1 second is gauged by space-ship traveler as 0.79678 second)

For example, if the length of the ruler or measuring device on the space-ship contracts by 70 % while the space-ship travels at almost the speed of light, the relative speed of 370,500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of 185,998.64 miles per second, which is in accordance with the Special Theory of Relativity:

185,998.64 miles = 111,150 miles (0.3 of 370,500 miles - due to ruler
1 second length contraction of 7**0 %**, 370,500 miles are gauged by space-ship traveler as 111,150 miles) ÷ 0.597585 second (due to clock on space-ship slowing down by **167.34 %**, 1 second is gauged by space-ship traveler as 0.597585 second)

For example, if the length of the ruler or measuring device on the space-ship contracts by 80 % while the space-ship travels at almost the speed of light, the relative speed of 370,500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), should be recomputed/gauged as follows to produce the “distorted” speed of 185,998.64 miles per second, which is in accordance with the Special Theory of Relativity:

185,998.64 miles = 74,100 miles (0.2 of 370,500 miles - due to ruler
1 second length contraction of **80 %**, 370,500 miles are gauged by space-ship traveler as 74,100 miles) ÷ 0.39839 second (due to clock on space-ship slowing down by **251.01 %**, 1 second is gauged by space-ship traveler as 0.39839 second)

However, if the length of the ruler or measuring device on the space-ship contracts by, e.g., 60 %, and the clock on the space-ship slows down by the same percentage, i.e., 60 %, while the space-ship travels at almost the speed of light, the relative speed of 370,500 miles per second of each of the space-ships, X (moving frame) and Y (moving frame), would remain the same, i.e., 370,500 miles per second, which is in accordance with the Special Theory of Relativity:

$\frac{370{,}500 \text{ miles}}{1 \text{ second}}$ = 148,200 miles (0.4 of 370,500 miles - due to ruler length contraction of **60 %**, 370,500 miles are gauged by space-ship traveler as 148,200 miles) ÷ 0.4 second (due to clock on space-ship slowing down by **60 %**, 1 second is gauged by space-ship traveler as 0.4 second)

Thus, as is evident from the above examples, which are in accordance with the Special Theory of Relativity, to arrive at the two speeds, i.e., 62,110.887 miles per second and 185,998.64 miles per second, as well as other speeds, obtained by using the formulas stipulated by the Special Theory of Relativity, $v = (b - a) \div (1 - ba/c^2)$ and $v = (a + b) \div (1 + ab/c^2)$, the clocks and the rulers or measuring devices on the space-ships traveling at almost the speed of light would have to each respectively slow down and contract in length **at different rates** (and definitely not at the same rate). The only exception is evidently the case of the constancy of the speed of light, whereby the clock and the ruler or measuring device have to each respectively slow down and contract in length **at the same rate**, giving the **same percentage** decrease in the time gauged and the distance gauged**,** as follows, as stipulated by the Special Theory of Relativity:

(186,000 miles - X % of 186,000 miles) ÷ (1 second - X % of 1 second) = 186,000 miles per second

Why is the constancy of the speed of light the **exception**? Was it an adjustment or modification of the mathematics to “ensure” the constancy of the speed of light? Could the speed of light not be variable, below, at and above 186,000 miles per second at various times, as some have suggested?

Let us look again at the case of the constancy of the speed of light. We have stated that according to the Special Theory of Relativity the speed of a beam of light (c = 186,000 miles per second) would always be found to be constant or unchanged when gauged by a person traveling close to the beam of light in the same direction at almost the same speed as the beam of light (say 0.9c = 167,400 miles per second) because the clock and ruler or measuring device used by the person traveling in the same direction at almost the speed of light in gauging the speed of the beam of light would have respectively slowed down and contracted in length **at the same rate** (say X %).

We have to remember that the speed of the beam of light is obtained by dividing the distance traveled by the beam of light (as gauged by the ruler or measuring device on the space-ship traveling at almost the speed of light - moving frame, which has contracted in length) by the time it took to travel that distance by the beam of light (as gauged by the clock therein the space-ship - moving frame, which has slowed down), the gauging being carried out by the traveler on the space-ship (moving frame). Let us, using a simple example, say that the one-metre-long ruler used to gauge distance has contracted in length in the direction of motion by 20 %. The clock used to gauge time, which has also slowed down by 20 %, according to the Special Theory of Relativity, would now gauge the time taken, say X, to travel the distance between two designated points (reference, stationary frame), say Y, as having decreased by 20 % to become 0.8 X. Though the one-metre-long ruler, which has contracted in length by 20 %, still reads “1 metre” in length, it is in effect shorter by 20 % (actually only 0.8 metre in length). Therefore, when it gauges the distance traveled, Y, above, this distance Y would now be gauged as 1.25 Y, and not 0.8 Y in accordance with the Special Theory of Relativity. As stated above, Special Relativity theorizes that for the speed of a beam of light to remain constant the beam of light would have to take less time (time dilation) to travel a shorter distance (length contraction) - in effect, X % less time to travel a distance shorter by X %, in accordance with the above-mentioned equation, which implies that the speed of the beam of light would remain constant, e.g., 0.8 X (time) to travel 0.8 Y (distance) after “time dilation” and “length contraction”. But, as explained above, this would not be the case; the beam of light would have been gauged as having taken 0.8 X (time) to travel 1.25 Y (distance). This is an anomaly and it shows that there is something not right with the Special Theory of Relativity.

Since light particles (photons) do not have mass or inertia, which prevents an object possessing it from accelerating beyond the speed of light, viz., 186,000 miles per second, theoretically there is nothing to prevent light particles (photons) or other objects without mass or inertia from traveling at a speed greater than 186,000 miles per second.

Faster Than Light Travel

What would be the speed of the beams of light from the head-lights of a vehicle traveling at, e.g., 0.0083 mile per second, or, 30 miles per hour? If gauged from outside the moving vehicle (stationary frame) it should normally be 186,000.0083 miles per second (speed of the moving vehicle (0.0083 mile per second, or, 30 miles per hour) plus speed of each beam of light (186,000 miles per second)), but, according to the Special Theory of Relativity, this is not the case and the speed of the beams of light is not 186,000.0083 miles per second but still 186,000 miles per second (constant). How come? This is because light travels on its own independently of or unaffected by its source, in the above case, the source of the beams of light being the head-lights of the vehicle traveling at 0.0083 mile per second, or, 30 miles per hour.

In the above case, the beams of light are so much faster (186,000 miles per second) than the speed of the moving vehicle (0.0083 mile per second, or, 30 miles per hour) that they would be continually moving way way ahead of the vehicle after they leave the head-lights. Logically, if the vehicle had traveled at a speed exceeding the speed of light (which according to the Special Theory of Relativity is impossible - no object could travel faster than the speed of light - it is only an assumption here for the sake of argument) and continually "overtaken" the beams of light that its head-lights had emitted, the beams of light (whose speed remains the same at 186,000 miles per second - constant) should not be in front of the head-lights. If the vehicle were traveling much in excess of the speed of light, the beams of light emitted from the vehicle's head-lights should tag behind the vehicle. This is counter to our normal experiences with light beams from the head-lights of moving vehicles, which always appear in front of the vehicles.

The following equation shows that no moving object could travel faster than the speed of light, which is in accordance with the Special Theory of Relativity:-

$$v = \frac{a + b}{1 + ab/c^2}$$

If we let a = velocity of moving train, b = velocity of light beam (which is sent from the back of the moving train to the front of the moving train) with respect to the moving train, which is the moving frame (i.e., the velocity of the light beam (which is sent from the back of the moving train to the front of the moving train) is gauged from the moving train, which is the moving frame), v = velocity of light beam (which is sent from the back of the moving train to the front of the moving train) with respect to the ground level, which is the stationary frame (i.e., the velocity of the light beam (which is sent from the back of the moving train to the front of the moving train) is gauged from the ground level, which is the stationary frame), c = velocity of light = 186,000 miles per second, and, also let a = b = c, then:-

$$v = \frac{c + c}{1 + c.c/c^2} = 2c/2 = c! \text{ (And not 2c!)}$$

Though theoretically no object could travel faster than the speed of light because at the speed of light the object's mass is infinitely great and therefore it is unable to accelerate, an object without mass, possibly, a quantum particle which is somewhat similar to a photon (a photon is a quantum particle without mass always in motion) might be capable of traveling faster than the speed of light. Such an object or objects might be waiting to be discovered. As it is, a "theoretical" particle which travels faster than the speed of light, which is termed "tachyon", has been thought to exist.

There have been a number of speculations pertaining to the variable speed of light (VSL), e.g., one theory states that the speed of light varies with the various stages of the evolution of the universe, exceeding 186,000 miles per second at certain points of time.

Time-Travel

In the Special Theory of Relativity it is implied that an object traveling at more than the speed of light would go backwards in time, which is bizarre, but has evidently been taken seriously by quite a number. If time-travel were indeed possible, a person could go back to the time before he was born and murder his grandfather so that his father, and, hence, himself, would not have been conceived, which is against causality, paradoxical and absurd, thus implying that time-travel is not really possible.

After an object had contracted to zero length at the speed of light, it would actually cease to exist. Could an object really exceed the speed of light, contract in length further to "minus something" length from zero length or non-existence and travel backwards in time, as have been postulated by a number of people who hold the view that time-travel is possible? Negative quantities, e.g., negative lengths, as such, are evidently abstractions devoid of any real meaning or existence. For instance, a string which is minus one foot in length or a boat which is minus ten feet in length is meaningless. The idea of time-travel suggested by the Special Theory of Relativity should be only regarded as a metaphor or curiosity; it should be regarded as something which might be theoretically possible but is not practicable. It is somehow comparable to one of those well-known paradoxes, e.g., Zeno's paradox whereby it is shown that Achilles would never be able to overtake a tortoise which was given a head-start in a race (which is absurd).

Stephen Hawking has stated that if time-travel were possible we would have had visitations from tourists from the future (which we have evidently none so far), which, according to him, shows that time-travel is not possible. But, what about the reports and books about alleged sightings of UFOs and encounters with or abductions by aliens or extra-terrestrials? Are these alleged aliens or extra-terrestrials not possible tourists from the future, beings with seemingly advanced technologies, technologies which seem more advanced than ours, e.g., flying saucers, instantaneous appearance and disappearance which are suggestive of teleportation, et. al.? It is also possible, and seemingly much likely, that such beings, if they indeed exist, are from a civilization or civilizations from another part of the universe or another universe, which are more advanced than ours. There have been much stories and speculations pertaining to time-travel or teleportation. It has been discovered that quantum particles could be teleported, i.e., made to appear instantaneously at another location. If only there is a technology to teleport all the atoms in the body of a human being so that the human being could appear instantaneously at another place without physical and mental harm.

The stipulation of the impossibility of exceeding the speed of light by the Special Theory of Relativity means that time-travel is not possible, and Einstein had stated that time-travel is impossible. Though time-travel in the physical dimension is evidently impossible, time-travel in the domain of the consciousness or mind is possible.

Conclusion

The Special Theory of Relativity postulates that on approaching the speed of light a person's brain, as well as bodily, functions slow down, which partly explains why the speed of light would remain unchanged to him under all circumstances; in other words, he experiences the slowing down of time on approaching the speed of light. It implies that the person's mind could travel backward and forward in the space-time continuum. The mind is evidently closely linked to the "time" dimension of the space-time continuum, while the three coordinates of length, breadth and height make up the "space" dimension of the space-time continuum. We could equate the mind and time as follows:-

$$C = S^t$$

where C represents consciousness and S^t represents sense of the passing of time

Thus, there ought to be a Theory of Consciousness allied to the Special Theory of Relativity, which would contribute to an important understanding of the workings of nature.

Finally, a number of important points raised in this paper should be looked into.

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