Sparring with the Champ: Interacting with Selected Mental Experiments and Related Rationale Describing Einstein's Theory of Relativity

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June 10, 2011

Table of Contents

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Abstract

In 1905 Albert Einstein wrote the first papers on his theory of relativity. Fourteen years later he wrote a book utilizing several "mental experiments" to explain his theory. Einstein thus set this apparatus as a means for presenting and explaining concepts of relativity that continues even unto today.

The present article questions the validity of aspects of, and conclusions drawn from, the mental experiments supporting relativity: Is movement most accurately measured against random "rigid bodies," or do these experiments rather suggest that there is a better method? Must light always travel at the same speed relative to all reference points? Or do the experiments suggest that it may be possible for an observer to see a beam of light travel at other than the speed of light, and to do so while that beam has not actually varied from its inherent velocity? Are the experiments at times skewed by mislabeling perception as relativity? Are unfounded assumptions made about the inertial attributes of light; and what are the deeper implications if the experimenters' assumptions of light-inertia are correct? Do the experiments show a faulty framework that, when corrected, allow for an easy answer to what was thought to be a knotty problem – and in the process even remove the necessity for warping space/time?

This article grapples with these and other questions, suggesting alternate answers and insights as questions are raised. Ultimately the author finds sufficient reason to question the validity of a dogmatic acceptance of the Einsteinian relativity as presented in the mental experiments.

Introduction

Sparring: In part, the placing of a non-contender – often a virtual nobody in the sport – in the ring with a fighter in order to challenge and strengthen the fighter by identifying weaknesses that need to be improved. The concept of sparring well characterizes the intended nature of the interaction within this paper: A nobody contesting with the champ – not as one wishing to capture the title from him, but rather simply questioning points of possible weakness within his stance.

In the one corner stands the Champ: Einstein. Unquestionably the most noted physicist of the twentieth century, this is the Nobel Prize winning father of modern physics.

In the other corner, the Nobody – which would be me. The reader should be aware that although having a long-time dormant general interest in physics, I lack any significant formal education in this field, and have none in the specific area covered in this paper. My college education in the field of science is limited to a small degree (Associates Degree in Electronics), and studies in general physics are limited to a year in high school and one college class. The interest in the specific area of this paper is only recently pursued and confined to what has been self-taught.

This naturally leads to the question of whether I am qualified to spar with someone such as Einstein. That is a valid question – but a question that Einstein has himself addressed. In the preface of his book[1] he writes,

> This present book is intended, as far as possible, to give an exact insight into the theory of Relativity to those readers who, from a general scientific and philosophical point of view, are interested in the theory, but who are not conversant with the mathematical apparatus of theoretical physics. (Preface, p. v.)

In other words, Einstein wrote this book for people like me – one having a general scientific interest in the theory, yet lacking familiarity with the mathematical bases behind it. Since the book was written for people such as myself, this argues for the validity of the intellectual interacting presented in this paper. In other words, one can not wave off the honest questions presented here as being from one who is not conversant with the subject since, according to the author, the book was written to be understood by those in exactly my position.

But is such sparing necessary? Some might – and some have – asked, "Why question? Why not accept what has been established and what has been confirmed by a century of scrutiny?" In response I ask: Is not an honest question in itself worthy of

[1] This paper will reference by page number the following specific edition: Albert Einstein, *Relativity: The Special and the General Theory*, 2nd ed. (New York: Crown Trade Paperbacks, 1961). However, citations will also reference the work by citing specific chapters and paragraphs in order that the reader can follow in other editions, e.g., the following online version: Einstein, Albert "Relativity: The Special and General Theory" http://www.bartleby.com/173/ (accessed February 14, 2011).

consideration, and worthy of an attempted answer? Furthermore, it seems ironic that those who honor the man who crafted the theory of relativity are so quick to disrespect the very process (i.e., questioning the “established” rules) by which that man arrived at his theory? If the need for blind acceptance of established theory is sufficient reason to criticize such questions, then Einstein himself must also be under the same criticism for he did not allow the established rules of physics to prevent his questions that ultimately led to his new theory.

So, I – the unknown scientific-nobody – enter into the ring to respectfully challenge the Champ. Specifically, in the first part of this work I will interact with Einstein from the first portion of his own paper as he explains his ideas on Special Relativity. The balance of the paper will be given to interacting with a classic illustration of relativity and the implications drawn from it.

Most fighters would consider it a privilege to be the sparring partner for a champion in their sport. The reader should be aware that I similarly approach this project with no disdain for this champion of physics, but rather hold what I know of his scientific work in high regard. What is undertaken here should not be misconstrued as a wholesale criticism of either the scientist or his theories; rather, it is to challenge specific elements of his work only in an effort to identify weaknesses that may need to be addressed and improved.

Now we turn to consider the writings of Einstein.

Interacting with Einstein's Writings On

The Special Theory of Relativity

Chapter Two

In summarizing the discussion of this chapter in its final paragraph, the author notes, "Every description of events in space involves the use of a rigid body to which such events have to be referred." (¶ 10, p. 9; emphasis added.) With all due respect to the author, I have to question this. Need the reference point of every event be a rigid body? For example, is not the speed of sound often referenced against or measured relative to the medium through which it travels (e.g., air) – a medium which itself could be moving or otherwise less than rigid?

I must also wonder about the validity of using the term "rigid body" within the framework of relativity. It seems that the nature of such a term runs counter to the basic precepts of this field of study. Since relativity ultimately argues for the absence of an absolute reference point, isn't the idea of rigid out of sync with such foundational concepts? "'Rigid,' relative to what?" one must ask. "'Rigid,' as opposed to what?" is another important question to be addressed before rigid can be understood and rightly used within relativity's framework. What warrants the labeling of observers on the ground or in a train as having a more rigid position than, say, the molecules of air through which a stone or ball may be thrown, or the vacuum of space through which light travels? So, in the final analysis, is there any body or position that relativity may legitimately label as rigid without an absolute reference point? (Conversely, I must wonder if the author's use of the term bespeaks of an unrealized necessity of some form of absolutes.)

To summarize my responses to this chapter:

1. Is there really a necessity to reference all factors of movement to a so-called rigid body?
2. Is it not possible, preferable or even necessary at times to reference movement to the medium (e.g. air) through which something (e.g., sound) is traveling?
3. Is "rigid" even a valid concept within the precepts of relativity?[2]

Chapter Three

Einstein begins his consideration within this chapter (¶ 2, p. 10) by describing the path of a stone dropped outside of the train by a hypothetical train-rider. As Einstein notes, the effects of air resistance are momentarily set aside, the stone drops in a straight line relative to the rider, while its trajectory is a descending arch relative to someone at a rigid position on the ground.

But suppose that we don't track the stone's path relative to individual rigid positions, but rather relative to its Travel Medium (TM), which is here the air through which it travels. At every fraction of a second the stone's position can be plotted within and against that medium – i.e., relative to the individual molecules of air. That the rider's

[2] For simplicity's sake this paper will continue to use the term "rigid" as Einstein uses it, but with the disclaimer that it seems inconsistent with precepts of his theory of relativity.

train-produced movement distorts his ability to perceive a component of the stone’s travel through its TM does not change the actual trajectory of the stone, nor does it authenticate the distorted perspective of the one so influenced by it.

On a side note, this mental experiment (ME) only works as Einstein portrays because of the momentum/inertia of the stone – inertia that was transferred to the stone by the train’s movement. Should the stone lack such inertia it would drop straight to the embankment relative to the outside observer, while relative to the man onboard it progressively trails further and further backward in a somewhat diagonal trajectory toward the rear of the train.

While I understand and accept Einstein’s intention of disregarding air resistance, I trust the reader understands that in reality the effects of air (the TM for the stone) resistance are not negligible. The air offers no resistance only when it is traveling in the same direction and speed as the rider and train (e.g., if the stone were dropped inside the train where the air’s inertia moves it (the air) along with the train).

To summarize the observations made about this chapter:

1. As alluded to in the previous chapter, the movement of an object can be referenced to and measured against its TM (Travel Media).
2. The movement (direction and speed) of the object is influenced by the momentum/inertia of that object.
3. The movement of the object may also be influenced by the momentum/inertia of its Travel Medium, (as evidenced by the real-world difference caused by air

resistance when the stone is dropped outside the train as compared to its being dropped inside the train).

Chapter Five and Six

Einstein attempts to advance some points of relativity by utilizing an ME based upon a raven and a train. But the validity of these points is quickly undermined – whether due to the fault of the illustration or of the theory behind it, I do not know – as one considers a slightly adapted version of the same experiment: Suppose that both the train and the raven are traveling in parallel straight lines at 10 MPH (relative to the ground). After an hour the bird has traveled a distance of 10 miles relative to the ground. According to the physics work formula (w (work) = f (force) x d (distance)), its total work for that period can be loosely expressed as 10f. However, the theory of relativity argues that, *relative to the train*, the bird has not been moving at all, and therefore, after an hour's time the bird has traveled a total distance of zero miles. The work formula thus determines that the bird has done no work at all (0f). Relativity thus seemingly requires that the raven is doing both work and no-work for a single given activity. Expressed mathematically, in this experiment relativity necessitates that 10f = 0f (where f (force) is obviously not zero).[3] This arguably brings the validity of the ME – if not relativity itself (either in whole or in part) – into grave question.

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[3] This ME, therefore, implies that relativity – in the whole or at least in certain of its individual parts – is only true in the absence of all force, i.e., when f=0 (which is the only condition for which the given equation is true).

Consider the implications of another adaptation of Einstein's experiment: a physicist measures and calculates the force, distance and work that resulted from a battery-powered toy airplane traveling at 10 MPH velocity (relative to the ground) for a given period of time. On a subsequent occasion he repeats the experiment, noting the same amount of battery energy is expended, indicating that the same amount of work is done since all the plane's specifications (e.g., weight, propeller speed) remains constant. But on this second occurrence he observes that the plane only produces one-half of the velocity (5 MPH, relative to the ground), and thus only half the distance is covered in the same amount of time. Further observation reveals that in the second occasion the plane is in fact flying into a head wind of 5 MPH (also relative to the ground). These findings place the physicist in a quandary: on the one hand the work formula insists that the plane must have traveled equal distances in the two scenarios.[4] Yet, on the other hand the physicist's real-world observations show only half the distance is covered. So, which is right?

I suggest that they are *both* right. The apparent discrepancy arises from a failure to differentiate between measuring frameworks. Specifically, the problem is in the failure to see (1) that the plane does travel a consistent distance in the two scenarios *when*

[4] Note that force (specifically, the turning of the plane's propellers) is the same in the two scenarios. Total work done (as measured by identical amounts of battery power used on identical forces) is also consistent. With identical work and force, the work formula insists that the distances must also be identical.

measured against its TM, and (2) that the TM itself is being moved in the latter scenario which distorts the observer's perception of the plane's distance. Yet the plane's distances in flight are very different in the two scenarios when measured against any rigid point (e.g., the ground). Thus, in the case of the plane this law of physics seemingly demands that movement is not properly measured against rigid positions as Einstein sets his ME. Rather, this experiment argues that some instances of movement are only validly calculated/measured against an object's TM.

Consider yet one more alternate ME: A balloon is filled with a helium and air mixture such that it remains suspended in air, neither rising nor falling. When first released the balloon may have some small level of energy transferred to it from its handler, but in due time that energy dissipates as the balloon encounters resistance in moving through the air and it soon comes to rest. But it is at rest – i.e., zero movement – relative to what? Not relative to people, for they may be moving about as the balloon remains at rest. Nor is it necessarily at rest relative to rigid positions on the ground, for a draft or breeze may move the balloon and its environment (surrounding air) along. Reason suggests that the balloon is in fact at rest relative to the air – its TM. If the air moves towards the north, the balloon (while expending no energy and thus producing no work (i.e., at rest)) drifts to the north; if the wind shifts to the east, the balloon shifts accordingly. Thus, this balloon, when at rest, is going zero distance *only* relative to its TM. This seems to confirm that the TM is a preferable point of reference from which to determine true movement.

Returning to another concern in chapter five, we find Einstein stating,

> If, relative to [the Galileian co-ordinate system] *K*, *K'* is a uniformly moving co-ordinate system devoid of rotation, then natural phenomena run their course with respect to *K'* according to exactly the same general laws as with respect to *K*. (¶3, p. 16.)

But what is the reason for such a determination? Since Einstein's goal is to help his readers understand relativity it is surprising that he fails to explain the grounds for such a fundamental assertion – an assertion that his book shows to be foundational to his theory. But in contrast to this assertion, I believe that under scrutiny his MEs, if their implications are followed to their logical conclusions, will actually evidence an opposing interpretation.

To summarize my thoughts from the readings in chapters five and six:

1. Physics' work formula forces one to reconsider the ME's premise that all rigid points give equally valid, though differing, realities.
2. Rather, the discussion suggests that this formula argues for a single absolute point of reference, against which the speed of the moving object is best measured.
3. The additional mental experiments arguably confirm that a more valid point of reference for measuring movement is the medium through which an object is moving.

4. Rationale is surprisingly lacking for the pivotal determination that all phenomena will act exactly the same in all "uniformly moving co-ordinate systems."
5. Even if such uniformity were theoretically substantiated, one must ask if it is not possible that this uniformity is actually found in measuring movement against an absolute reference point (e.g., an object's TM) instead of so-called rigid points?

Chapter Seven

Einstein falls back upon an earlier questioned assumption, this time specifically associated with the propagation of light: "Of course we must refer the process of the propagation of light . . . to a rigid reference-body (co-ordinate system)." (¶3, p. 22.) But *must* we?

Consider the terms normally used in discussing the movement of sound waves. Expressions such as these are common parlance: "[The] speed of sound … through … dry air … is 331.29 metres (1,086.9 feet) per second. The speed of sound in liquid water … is about 1,439 metres (4,721 feet) per second."[5] In both cases the constant speed is given as *relative to the medium* (TM) through which it is traveling.

[5] "speed of sound." *Encyclopædia Britannica. Encyclopædia Britannica Online*. Encyclopædia Britannica, 2011. Web. 18 Feb. 2011. <http://www.britannica.com/EBchecked/topic/559127/speed-of-sound>, emphasis added.

Environmental factors may move the air (TM) through which sound is traveling, affecting observers' perception of that sound. Also, the Doppler Effect compresses and then expands sound waves as the sound source is traveling through the TM. Yet in each case the speed of sound is constant relative to its TM, even when the TM is itself moving or the sound source is moving within the TM. Furthermore – and apparently contrary to Einstein's ME settings (see chapter five) – in such cases the speed of sound is *not* necessarily consistent relative to all "rigid" positions (e.g., those observing the distortions caused by the Doppler Effect).

In light of all the above, I must ask what logical reason or experimental evidence indicates the same can not be true for the propagation of light. Can the proper measurement of its speed not be made relative to its TM rather than a rigid point?

1. As mentioned earlier, do the inferences of relativity really allow anything to be considered "rigid," as distinguishable from "non-rigid?"
2. I have previously forwarded that the work formula of physics suggests that for the raven and plane – and arguably for similar objects – components of work/movement are at times most accurately accounted for when measured against an object's TM, not a rigid reference point.

In his next illustration (¶3, p. 22) Einstein states that from onboard the train the perceived velocity of a beam of light (w) cast from a point along the embankment, made in the same direction and parallel to the train, can not be calculated as

$$w = c - v$$

where *c* is the speed of light and v is the velocity of the train (both relative to the embankment (ground)). This formula is deemed problematic because he understands it to be a violation of the general law of nature that demands that "the law of the transmission of light *in vacuo* must, according to the principle of relativity, be the same for the railway carriage as the reference-body as when the rails are the body of reference." (¶4, p. 22-23.) In other words, Einstein holds that all observers must see light travel at *c* relative to their circumstances, regardless of their own movements. But I am hesitant to accept this, because:

1. It is based upon the author's unexplained belief that all natural phenomena act identically in uniformly-moving coordinate systems.
2. It is inconsistent with findings from previous MEs. Would Einstein also hold that, substituting the raven for the beam of light, the two rigid points in different coordinate systems would perceive the bird traveling at the same relative speed? Obviously not, as he plainly indicated earlier. So what is the rationale for treating the beam of light as if it were different? This makes one wonder if Einstein believes the findings of the previous ME or not.
3. Einstein's argument is based upon the questionable necessity of making a rigid point the place from which motion/travel is measured. The discussion presented thus far suggests that a beam's TM is possibly (probably?) a superior reference point than either the train carriage or the embankment (ground). From such an absolute motion-reference-point (i.e., the TM) light's

movement relative to any rigid position can then seemingly be calculated by simply beginning with *c* then adding or subtracting any movements of the TM relative to the rigid point(s).

Chapter Nine

The points made in this chapter's experiment seem so baseless and easily discredited that I have to seriously wonder if I've misunderstood the great physicist's meaning. Here Einstein contends that two events happening simultaneously at rigid points along the embankment are not necessarily simultaneous for a man observing them on a moving train.[6] Instead (the author claims), the event toward which he is going happens sooner than the event from which he is leaving.

However, the author is seemingly unmindful of some impacting factors, including the following:

1. While the simultaneous events (A & B) happen as the train's observation point (M') is rolling over the on-ground mid-point (M), the speed of the train actually moves M' away from M during the time period at which the light is traveling from both A and B to M. Since the train has now moved, M' is *not* at the midpoint when the beams later reach the train, making this measuring system inadequate to properly evaluate simultaneousness. The onboard

[6] The reader can find a helpful diagram of this mental experiment in either chapter nine of the aforementioned book or website (http://www.bartleby.com/173/9.html).

perceived non-simultaneousness is thus due to a fault in the experiment's design, not a difference between the onboard and off-board realities. Generally similar results in perceived non-simultaneousness would be seen by an observer stationed at N (some point on the embankment between the points where M' received light from B and then A). Since N is in the same coordinate system as M relativity is obviously not to blame for the difference in observations (or supposed "realities").

2. A larger flaw, it seems, is that this illustration presumes to equate perception with reality – i.e., the difference in perceptions is interpreted as a difference in realities. But just because the man on the train doesn't perceive the two events as simultaneous does not prove they are not simultaneous. Did the two lightning strikes originally happen at the same "tick of the watch" on the onboard observer's wrist (as Einstein implies in describing this ME)? If so, then the events were, by definition, simultaneous. Period. Surely Einstein does not wish to imply that an observer's perception trumps this.

Consider an alternative ME in which a man is watching a bullet fired towards him along his line-of-sight. If we momentarily disallow the effects of gravity, the man does not perceive any movement since the bullet moves neither up or down, nor left or right – even though the bullet is actually traveling straight towards him. Thus, we find that perceived non-movement does not prove there is no movement. Thus, perception can not be assumed to be synonymous with relativity – or reality – and the legitimacy of Einstein's argument in this ME is therefore in question.

3. It seems that even the presentation of this mental experiment bespeaks of an assumed – or even required – "absoluteness," as Einstein describes the whole ME from a "third-person, all-knowing" perspective. Such an absolute perspective – i.e., the ability from a location removed from the experiment to reliably understand, describe, anticipate and/or evaluate what is happening within the experiment – is the natural approach of scientific experimentation. In verbally walking through the experiment Einstein definitively states that the lightning strikes are simultaneous from one perspective and that they are not simultaneous from a second perspective – both made without actually sitting in those perspectives, but rather made from some above-the-experiment all-knowing vantage point. Yet Einstein takes such an approach while in this very ME he functionally argues that such an approach is invalid. This ME arguably necessitates that there is no such position from which one can have an absolute perspective to observe and evaluate the experiment – no place beyond relativity's impact which can distort the observer's ability to know another's reality. If Einstein is correct and the observers on the train and on the embankment see totally different but equally valid realities without knowing the observation and reality of the other observer, then one must wonder how can Einstein presume that as a third observer he himself can

either properly state the simultaneousness of the lightning strikes or properly anticipate what the first two observers will experience. Is the great physicist presuming that he can have his cake and eat it, too – that he can insist on concluding that relativity touches all positions while presuming his own position in making that conclusion is above being tainted by the possible distortions of relativity?

The scientific process which enables the scientist to observe, evaluate, and draw conclusions upon an experiment, requires an appreciable degree of non-relative third-person-perspective objectivity, and in fact is meaningless without it. But if the various aspects of Einsteinian relativity as explained in this ME are true, the resulting implications argue that a scientist is incapable of the objectivity necessary to do his job, and the whole scientific process is undermined beyond use. Thus, in a twist of great irony, if a person accepts Einstein's conclusion in this ME, that belief must ultimately force him to distrust the conclusions of this ME, and arguably Einstein's theory itself.

Interacting with The Classic Spaceship Mental Experiment

Although not found in my reading in Einstein's book – and thus, maybe something not connected with Einstein himself – the mental experiment that first attracted my interest to the theory of relativity is the classic illustration of the spaceship and the bouncing beam of light. This illustration goes as follows: Observer 1 (O1) is onboard a spaceship (SS) traveling at the speed of light (*c*),[7] while Observer 2 (O2) is on earth watching as SS travels a flat trajectory across the horizon. Onboard the in-flight SS a beam of light (B) is shot straight down from the ceiling (point X); the light strikes a mirror on the table (point Y) five feet[8] below X, then bounces back to the ceiling (point Z,[9] which from O1's perspective is the same as X). O1 sees B traveling at *c*, making the round trip (X ⇨ Y ⇨ Z) as two identical and overlapping line segments of 5 ft. each, for a total path of 10 ft.

The illustration then shifts to O2 who, from his position on earth, watches through a window in SS as B travels from ceiling to mirror to ceiling (i.e., X' ⇨ Y' ⇨ Z'). However, in this movement O2 observes a lateral component of B's path as B travels along within SS (which O1, being a part of SS's movement, is unable to recognize). Therefore, instead of the O1-observed trajectory of two identical overlapping 5 ft. line segments (10 ft. total), relative to O2 B takes a longer downward diagonal path from X' to Y', and then an upward diagonal path from Y' to Z' – with each of the two segments

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[7] Presentations of relativity often disallow the possibility of objects actually traveling at *c*. However, for simplicity in presenting this discussion such a limitation, if it actually exists, is here tentatively set aside. The ideas presented in this section should also hold basically true for SS speeds of less than *c*.

[8] Some details (e.g., this measurement) vary or are omitted in the various presentations of this ME. These are given here to facilitate the discussion of my observations. Also, although I have never heard this specified, this study presumes the cavity of SS to be empty of air, with the light traveling *in vacuo*.

[9] The reason for this separate designation will be evident momentarily.

of that V-shaped course being 7.07 ft.[10] (totaling 14.14 ft. for the full trip). It is important to note that O2 sees B cover the 14.14 ft. in the same amount of time that O1 observes the light travel 10 ft. Therefore, if O1 sees B cover 10 ft. at *c* (so the argument goes), this forces B to travel at faster than *c* relative to O2 – a thought that is quite bothersome to Einsteinian physics. Therefore the ‘warping’ of time and space is deemed necessary to allow the speed of B to be *c* relative to O2.

However, a number of questions arise in considering the above:

#1. Perception vs. Reality? As previously discussed (chapter nine) one can not presume that perception is reality. Just because O1 perceives B taking a 10 ft. path does not necessitate that the path is actually 10 ft. rather than the longer 14.14 ft. (as seen by O2). It seems preferable to believe that O1 really observes B travel through the 14.14 ft. at *c*, but it only *appears* to go at less than *c* due to the vehicle-produced movement that distorts O1’s perception. (Cf. the earlier train-rider discussion in chapter three.)

#2. Framing of the Problem? Next, I question framing the discussion of this ME as O1 seeing B traveling as *c*, resulting in the necessity of O2 seeing B at greater than *c* (barring effects of special relativity). I suggest that the better

[10] This distance is found by knowing that since SS is traveling at the same speed as B (i.e., both at *c*), the horizontal distance that SS travels forward must equal the vertical distance that B travels (i.e., the 5 ft. from X’ to Y’) in the given period of time. By the Pythagorean Theorem we then calculate that the diagonal “hypotenuse” through which B appears to travel is 7.07 ft.

understanding comes from first considering that O2 sees B travel at *c*, then attempting to explain why O1 seems to see B traveling at less than *c*. Then, as described in #1 above, the latter is readily explained as B actually covering the longer 14.14 ft. path, while only *appearing* to O1 to travel the shorter 10 ft.

#3. Relative Constancy of Light Speed? As previously noted, the fact that Einstein states without substantiation that light travels at the same speed relative to all rigid points is quite strange, especially when such relative consistency is not required for other moving objects (e.g., sounds, birds). Since some of his ME suppositions have been shown to be of questionable validity, and since the relative consistency of the speed of light is so pivotal to this ME, it is of great importance to substantiate this premise in order to evaluate the validity of the conclusions drawn.

#4. Momentum/Inertia of Light? This ME is built upon another unsubstantiated presupposition – the assumption that light (B) has momentum/inertia. But is there evidence to know or reasonably theorize that this is true? Comparing the above experiment to the train illustration discussed earlier in this paper, were O1 to bounce a ball in a vacuum within a moving train he would observe the ball follow a solely vertical path while O2 (from outside the train) would instead see the ball follow a "V" shaped trajectory. The ball's lateral component of movement is only possible because it has inertia acquired from the movement of the train – and thus, we deduce, the train and the ball are inertially-interconnected. But in the spaceship ME can we say with any degree of certainty that (1) B has inherent inertial or inertial-type attributes, and (2) if so, is there evidence to conclude B and SS are inertially interconnected – i.e., that SS can transfer inertia (specifically, in the form of lateral movement) to B? Or is it at least possible that B is inertially-independent of SS?

Lacking evidence to indicate that B has inertia or that SS will transfer lateral inertia to B, one wonders whether B, being aimed directly down from the ceiling of SS, will actually take the diagonal path relative to O2 as this experiment originally described. I suggest that it might instead continue to travel in its solely vertical path (as observed by O2), unaffected by SS's lateral movement. This will result in B missing the mirror and table altogether; instead it passes through the plane (M) of the mirror at a point (W) 5 ft. directly aft of point Y. If this hypothesis is correct, B will travel in a vehicle-independent vertical direction relative to O2, and this path will be observed by O1 as a reverse diagonal trajectory (cf. the earlier ball-without-inertia discussion in the latter part of chapter three).

#5. <u>Inertia of Light's Travel Media</u>? Of course, light itself need not have inertia for the SS ME to work as originally presented. The same results would be expected if its travel medium possessed inertial characteristics and was inertially connected to SS. But do we have reason to know or reasonably theorize that the TM for the light beam has such inertial characteristics in this setting? I return to the train experiment, except that this time air is substituted for the vacuum, and an object having virtually no individual inertia (e.g., a feather or a particle of dust) is substituted for the ball. The anticipated results are virtually identical to the previous findings – that the object falls in a vertical line relative to O1 and in a forward diagonal relative to O2. This argues that the TM has inertial characteristics and impacts the trajectory, which in turn indicates that the train is also inertially interconnected with the TM. But can we say with any degree of certainty, (1) that the TM of light has such inertia or inertia-type characteristics, and if so, (2) that SS is inertially-impacting upon B's TM?

#6. An Alternate Outcome? If the consistency of *c* relative to all rigid points can be momentarily set aside, and allowing for both the alternative framing of the experiment discussed in #2 and the lack of proven inertia for either B or its TM (#4 & #5), I suggest the spaceship experiment may rather play out as follows:

- SS is traveling at *c*, and at T1 (the initial point in time) B is shined from X towards Y (which is in plane M), perpendicular to the path of SS.
- Relative to O2, B travels vertically at *c*, and at T2 has covered the 5 ft. to plane M, but instead of hitting at Y it passes through M at point W.

- Relative to O1, however, B (which, as previously specified, is inertially-independent of SS) is *perceived* as taking a diagonal path, trailing the onboard-vertical by 45° towards the aft of SS, and eventually passing through W. What actually happens – best visualized from a viewpoint outside of SS (and thereby removed from the same distortion encountered by O1 because of SS's lateral movement) – is B covers the (vehicle-independent) vertical distance (i.e., 5 ft. from X to M) as W moves forward the horizontal 5 ft. – both traveling at *c*. Both B and W eventually meet at the place Y had been at T1.[11] The end result is that the original distance from B to W at T1 (7.07 ft) is progressively reduced to zero as *both* B and W move toward the intersection point. Relative to O1 it appears that B has traveled 7.07 ft. in T (where T (Total Time) = T2 – T1), thus giving (only) the *appearance* that B is traveling at greater than *c*. But that perception is skewed because B's actual movement only covered the 5 vertical feet, and the horizontal component of the movement was *not* movement of B at all.

[11] This would be comparable to two cars, one from the north (cf. B) and one from the west (cf. W), approaching the same intersection (cf. the location of Y at T1), both traveling at the same speed from equal distances.

Also consider that to argue that B’s movement must account for the full 7.07 ft. at a speed of *c* would ultimately entail that B travels at *less than c* in its individual component (X ⇨ M) of that total movement – which would be problematic.

Throughout this study I have had to constantly remind myself that there is a distinction between “relative to” and “perceived by,” and the latter can not be misconstrued as the former. To illustrate the difference in the two, consider a man viewing a beam of light traveling away from himself along his line-of-sight. There is no *perceived* movement (including speed) as the light travels neither up or down, nor left or right; yet there definitely is *relative* movement as the light travels at *c* relative to the man. Thus, actual relativity must be differentiated from perception, and any inaccuracies fostered by the latter must not be allowed to skew findings and conclusions concerning the former.

Similarly, if this ME is to be properly understood a distinction must be made between movement that is perceived by O1 and movement that is relative to O1. O1 *perceives* B traveling the 7.07 ft. from X to W at a speed exceeding *c*. But as already shown this perceived speed is in reality the composite of (1) the movement of SS (and thus, plane M and point W within that plane) and (2) the solely vertical vehicle-independent movement of B from X to M. Once split into these two separate components we readily see that relative to O1, B is in fact moving at *c* even though *perception* may have wrongly concluded a faster speed. Thus, we find that light actually is traveling at a constant speed (*c*), relative to all (so called) rigid points – and this without the need for the warping of time and/or space.

#7. <u>If Light-Inertia is Proven?</u> If my hypothesis is incorrect and B and/or its TM indeed have inertial-type attributes and is/are inertially-interconnected with SS, it is still questionable whether O1 would see B travel X ⇨ Y ⇨ Z at *c*. As previously discussed, I rather think O1 would *perceive* B as going the 10 ft. path at what appears to be slower than *c*, while B actually traverses the 14.14 ft. at *c*, as outlined in #1 & #2 above. Surprisingly, this still results in B travelling at *c* relative to O1, although his own lateral movement distorts his ability to properly perceive elements of that trajectory.

#8. <u>Ramification of Light-Inertia?</u> If the spaceship ME in its original form is correct and the direction (a component of motion) of B and/or its TM is shown to be altered by an outside force (e.g., inertia gained from SS), that would hint that the speed (another component of motion) of B and/or its TM may also be influenced by similar forces. Arguably one can not allow the one component to be influenced by an outside force and yet arbitrarily disallow a similar influence on another component.

Restated, this means that perpendicular forces (e.g., the movement of SS) are capable of introducing (i.e., *transfer to*, or *add to* B) a lateral speed component to what would otherwise be a vehicle-independent solely-vertical speed of B. Adding a lateral speed to B's own vertical speed of *c* forces the *total* movement of B to exceed *c*,[12] (as calculated by the square root of the sum of *c* (vertical velocity) squared and lateral velocity squared), resulting in O2 observing B move at a speed that exceeds *c*.

Furthermore, if inertia from SS impacts the lateral direction of B when B is traveling perpendicular to it, one must arguably also allow that the same inertia will have a comparable impact were B traveling parallel to SS. In other words, the inertia from SS would add (positively or negatively) to the speed of B, resulting in B traveling (relative to O2) at either 2*c* (if B is traveling the same direction as SS) or at 0*c* (if B is traveling in the opposite direction as SS). Here again, one can not arbitrarily allow the impact in the one case (perpendicular inertial impact) without giving equal allowance in the other (parallel inertial impact).

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[12] A physicist may ask, "'Exceed *c*' relative to what?" I suggest that the answer to that question is found in the answer to another question: "When a jet passes the sound barrier, it is traveling at mach one relative to what?" It is not relative to the pilot. Nor is it necessarily relative to the ground as high wind-speed (relative to the ground) would seemingly impact that slightly. Rather, the jet passes the sound barrier as it exceeds the speed of sound within this particular TM (air).

In short, the natural implication of the SS ME requires that inertial impact is transferable to B, which in turn necessitates that B's speed can be altered. Thus, the ME is dependent upon B's ability to travel at speeds other than *c* relative to its TM (as well as relative to observers within that same inertial point of reference). On the other hand, if the inertial transfer to B is disallowed, one is forced to reconstruct this classic experiment, presumably finding results as given in #6 above. Either way, if this ME accurately illustrates relativity it seems that its implications question the *necessity* of a time/space warp, and requires the rethinking of some basic premises and conclusions of Einsteinian relativity.

Returning to consideration of sound, its speed is a constant within (and relative to) a particular TM (e.g. air). Is there reason to suppose the same can not be true for light within its own TM? Sound, while traveling at a constant speed relative to its TM, can actually exceed that constant speed relative to individual rigid positions if its TM is moving in the same direction as the sound. Mathematically the equation would be:

$$V(t) = V(s) + V(tm)$$

(Total velocity = velocity of sound + velocity of the travel media)

Is there evidence that reasonably proves a parallel scenario is not possible with light? Is it impossible that, for instance, B is moving at a constant speed within its TM, but that the TM is itself influenced/altered by outside sources, resulting in a sum of movements that makes B faster or slower than *c* relative to observers in rigid positions?

Summary

The concerns and questions presented in this paper can be summarized as follows:

1. The Possible Existence and Impact of Light's Travel Medium. Einstein's book shows no evidence that he addressed the possibility (let alone the impact) of the Travel Medium through which light travels, even though there is ready evidence of TM's presence and impact upon the trajectories of other objects.
2. The Travel Medium as the Proper Point of Reference. Einstein's rationale calls for referencing motion – including its component of speed – to rigid points. The discussion outlined here, verified by the very formulas of physics itself, questions the validity of such a model. Rather, it suggests that a more ideal model may be to measure speed relative to light's Travel Medium – a point of reference that may or may not be moving relative to specific rigid points.
3. Perception vs. Relativity. The discussion highlights that the difference between observer-perception and relativity must be vigorously maintained to properly frame, evaluate, and discuss the MEs of relativity. Yet it appears some observations and conclusions have obscured, ignored, or even crossed

that line of distinction – including (but not limited to) instances when an observer's own movement distorts his perception of light's actual trajectory.

4. The Net Movement from Multiple Moving Sources Wrongly Assigned to a Single Source. It seems that the total net movement from multiple separately-moving components (e.g., movement of a beam of light juxtapositioned over spaceship movement) is at times mistakenly ascribed to a single source of movement by some MEs.

This is illustrated by an adaptation of one of Einstein's experiments. Envision a man walking at 3 MPH inside a train which is traveling in the same direction at 100 MPH is traveling at a total net speed of 103 MPH relative to an observer on the ground. No one would presume that this net speed should be singularly attributed to the speed which the man is propelling himself. Yet some of the relativity MEs have failed to abide by this concept. The total net movement of the beam of light *and* the spaceship may make light move at faster than *c* relative to some observer. But can one presume to do here what wouldn't dare be done in the man-on-the-train experiment – i.e., assign the total relative movement to a single component (the speed of B's own propulsion through space) even when one would never assign the full 103 MPH to the efforts of the walking man?

Thus, I conclude, in a scenario which is known to have multiple individual movements, it seems unwise to presume to assign the total (net) relative speed to a single individual component. As a corollary, one must investigate any net (including relative) movement for possible multiple components before assuming that net movement is from a single source.

5. Insistence upon the Constancy of the Speed of Light. This paper has repeatedly highlighted the lack of defense for the assertion that light must always travel at *c* relative to any and all observers regardless of their own speed, direction or other situational factors. The discussion of the MEs has certainly shown this assumption to be suspect.
6. The Consistency of the Speed of Light is Not as Threatened as It is Presented. By utilizing (1) a proper framework in examining the MEs, (2) a proper differentiation between perception and genuine relativity, and (3) a proper differentiation of components in the net total movement that makes up relative movement, one finds that even without the warping of space/time the consistency of the speed of light has been maintained in the classic space ship experiment, not lost as we have been told would happen. I hypothesized that the same will also hold true in other MEs – and possibly in real-life as well.
7. Inertial Attributes. This paper has highlighted a number of questions related to the inertial or inertial-type attributes of light and/or its TM as necessitated by the implications of the MEs. Among them:
    a. Questionable Inertia. Although inertia of light and/or its TM are presumed in some MEs considered in this paper, the discussion to this

point has questioned this presumption. If, as I suspect, they are actually without inertia, then these experiments and related findings must be reworked, if not discarded.

b. Inertial Interconnectivity vs. Inertial Independence. If light or its TM is found to have inertia-type attributes as certain MEs imply, there still remains the task of determining if that inertia is interconnected with (influenced by) a specific vehicle in which light is “riding.” Actually, this question must be addressed on two levels: general and specific. In other words, even if light or its TM is determined to have inertia it still must be established that it has inertial interconnectivity with the given vehicle (general), and that the interconnectivity exists in each experiment under consideration (specific).

c. Ramifications of Light-Vehicle Inertial Interconnectivity. If inertial interconnectivity is proven, Einsteinian relativity must subsequently deal with the accompanying implications of the influence-ability of light. If one allows that an outside force can alter light’s perpendicular velocity without the warping of space/time, then he arguably must also allow that (1) an outside force can add (positively or negatively) velocity which is parallel to light’s movement – resulting in light traveling at speeds other than *c* (relative to its TM); and (2) such an alteration in parallel velocity is done without warping space/time. This is not an Einsteinian-friendly possibility.

8. <u>Absoluteness and Experimental Uncertainty.</u> As discussed at length in chapter nine, the presentation of relativity MEs – as well as all scientific process – is dependant upon having an appreciable degree of an all-knowing absolute perspective. If all observation is relative – and if relativity at times prevents one position from accurately knowing what is happening in another position (e.g., the supposed different "realities" in the simultaneous-lightning-strikes experiment) – then can scientific process be reliably accomplished at all? How can an observer know with any certainty that relativity has not skewed his observations of the events within that experiment, making the observations and resulting conclusions unreliable?

Additionally – and ironically – do not such characteristics of relativity as depicted in the MEs, if pursued to their logical conclusion, even undermine their own certainty? If all aspects of Einsteinian relativity are true, then relativity argues that we can not know for certain that it is real. If Einsteinian relativity affects all positions, then arguably we must acknowledge that conclusions drawn upon research – even concerning relativity itself – are unreliable due to the potential skewing by relativity.

For Further Study

As this study is being finished a few additional thoughts come to mind that seem worthy of mention and may prove beneficial as follow-up studies.

First, what exactly composes the Travel Medium of light as it travels in space? Identifying air or water as the TM of sound is pretty straight forward, but what is the TM of light in space, where there is no matter? And what (if anything) does the TM of light in the vacuum of space reveal about light's TM in other situations? Until the point that this TM is understood it will be difficult to practically measure light's travel against it.

Second, pertaining to the practical difficulty just mentioned, is it possible that the idea of measuring movement relative to a object's TM (as advocated in this paper) can be accomplished by measuring movement relative to that object's four dimensional original position (e.g., B within the coordinate system of SS (three dimensions) at T1 (the fourth dimension))? (See the following consideration for more details on the need for a four-dimensional coordinate system.) If the two systems are synonymous, this alternate description would be much easier to both conceptualize and utilize.

Third, there is an alternate framework which may better explain an inherent problem in the spaceship experiment – an idea which dovetails with this paper's earlier discussion of this experiment. It seems that ultimately the experiment presents a four-dimensional problem that the original experimenters attempted to solve in a three-dimensional framework. According to the original descriptions, O1 observes B travel from X to Y. However, that is not a full description of the situation. If light were to travel the route as originally argued, O1 would actually see B travel from X@T1 (i.e., point X at the location where SS was at the initial point in time) to Y@T2 – measurements that must take into account the movement of SS in space. In more typical settings, time (fourth-dimension) coordinates are not a factor in measuring movement (including distance and speed). However, in an experiment such as this in which (1) one movement (B) is set within another movement (SS); and (2) the latter object is used as the coordinate system for measuring the movement of the former, even though; (3) the former is not inertially-bound to the latter (as this paper hypothesizes is the case with B and SS); then the time coordinate does become necessary to properly determine factors of movement.

Furthermore, I anticipate that with the proper utilization of a four-dimensional coordinate system the problems of trains and stones or balls or ravens, and possibly even questions of – or need for – relativity itself, will disappear.

Fourth, the spaceship experiment is discussed in this paper with the assumption that the light beam within SS travels *in vacuo*. But I now wonder what would change were SS instead filled with air, thus making air become light's TM – a TM known to have inertial attributes. I am inclined to think that this would make no significant change to the outcome. If this is true, an additional consideration must be factored into determining interconnectivity. When attempting to establish *indirect* object-vehicle inertial interconnectivity[13] (e.g. connectivity via the object's TM), connectivity must be established between all relationships in the chain. In this particular situation, connectivity must be established between the vehicle and the air (TM), plus between the air and the light beam. I am inclined to believe there is connectivity between the former pair, but not the latter. If this assessment is correct, then there is no indirect interconnectivity in this instance.[14]

Fifth, if light has no inertia (as hypothesized here), then can we legitimately bind it to an inertial coordinate system? It seems that Einstein's relativity attempts to bind a single beam of light to *all* inertial coordinate systems (the mechanics of which is inconceivable) as he forces it to travel at *c* relative to every one of them.[15] But if light lacks inertia, it seems more fitting that it operates within a separate non-inertial coordinate system – one which possibly transcends all inertial-based systems. This, in turn, leads to a possibility that particularly intrigues me: Could it be that whatever frame of reference to which light is legitimately bound is the absolute reference system to which all other coordinate systems are ultimately subservient?

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[13] Direct object-vehicle inertial interconnectivity occurs when an object is in direct contact with the vehicle and receives inertial changes through that immediate contact (e.g., when a ball is resting on the floor of a train as the train begins to move or otherwise changes its motion). Indirect interconnectivity occurs when inertia is transmitted from vehicle to object through an intermediate medium (e.g., a balloon suspended in air on a train).

[14] I am inclined to question if air is actually the immediate TM of light if there is no inertial interconnectivity between the two.

[15] On a side note, it would seem that if light does have inertia that it could only be bound to the one inertial system that it is connected to, not to all systems.

Conclusion

In a day when time was kept by the pendulum swing, and in a place among the old-world countries as explorers first began to venture over the western horizon of the sea, there arose a grave concern among the folk of one country about what maladies such exploration might cause. Some even feared that this new form of travel might distort such foundational elements as time itself. In an attempt to allay this fear, the people synchronized two of their most exact timepieces, and after placing one in a shop on the wharf, they put the other on board the ship and set sail.

At the end of six days of travel, and having battled storms and high seas for much of the trip, the ship returned to harbor. A quick comparison of the two pendulumed time-keepers confirmed the fears: traveling the open seas does in fact warp time, as clearly evidenced in the three-hour difference in these most-accurate clocks of the day. The people docked the ship, forever grounded by their interpretation of the clear data. They never experienced the world before them because of a simple oversight: all failed to realize that *an* explanation for the data is not necessarily *the* explanation of the data. While the warping of time was a possible explanation for the difference of the timepieces, the actual cause was an unknown-to-them inability of the precision instruments to accurately work within the new condition of the sea-going ship.

As I look at the questions raised in this paper, it strikes me that we may face a similar situation. The yet-to-be-known has drawn man's attention and has begged him for an explanation. A hypothesis is floated, calculations made, experiments conducted, and data collected. According to the mental experiments, relativity is *an* explanation. But lest we too hastily accept this, I offer three questions to guide in our evaluation of whether it is *the* explanation. First, is Einsteinian relativity a valid explanation? Certainly this theory has offered new insights, answered some questions, and even properly anticipated some then-future experimental findings. But for its various benefits, according to its presentation in the MEs the theory is not without its difficulties – including implications that it proves the inability for anyone to know for certain that it is exists.

Second, is Einsteinian relativity the only explanation? I believe this presentation has clearly indicated that alternate explanations are compatible with what the MEs illustrate. And if there are alternate possibilities, the scientific community should not arbitrarily adhere to one option dogmatically and ignore (either theoretically or practically) the existence of others.

Third, is Einsteinian relativity the best explanation? In light of its associated difficulties (as seen in the MEs discussed here), as well as the availability of other explanations that are less peculiar, I am hesitant to give it high marks as the best explanation to the arguments presented in the MEs.

To summarize, having identified various problems with Einsteinian relativity as highlighted within these mental experiments, it seems this theory has a number of aspects which are faulty, making me hesitant to accept it as the best explanation of the available data. I thus feel that greater consideration should be given to alternate possibilities.

Specifically, I think what Einstein labels as “relativity,” at least to the degree that it is represented in the mental experiments, is better handled as follows:

1. Proper Differentiation and Allocation of the Separate Components of Movement. Net total movement must be broken into its individual components, with the various component movements properly assigned to the (sometimes separate) sources. While net total movement is a valid measure of the movement of one object in reference to another, it does not allow one to assume the total movement is due to a single object. For example, the movement components of an observer must not be ascribed to the object when it is the speed of the object that is being measured. Furthermore, one must realize that the individual movement of the observer may in fact skew his (or even others’) ability to properly determine the object’s actual movement relative to the observer.
2. Measure Movement in the Proper Frame of Reference. Obviously measurements must be done using proper beginning and ending points. This, I hypothesize, is achieved by measuring to the moving object’s TM. I feel that additional future study will confirm that this is best done by measuring to the object’s original position based upon a four-dimensional coordinate system referenced to the inertial system to which the moving object is bound.

So, with all due respect to Einstein and his intelligence that gave us such deep and wonderful scientific insights, I humbly submit the above to the readers to evaluate my questions and concerns. Am I totally off base? Do I possibly find myself simply arguing against the shortcomings of the illustrations, but without identifying valid fault with the theory of relativity itself? Or are the points I make valid – if not in the whole, then possibly in any of its individual parts? Among the various issues presented, are there aspects that are worthy of further consideration?

With that I close, leaving with you the reader my hopes that those more knowledgeable in this field will correct any errors in my judgment and explain the answerable questions. If there are any worthy concerns found herein, following the pattern given us by the great physicist I hope that such questions which challenge the status quo will be the impetus for developing the next stage in the evolution of this fascinating field of science.

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