Types of Time Machines and Practical Time Travel

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Abstract

Based on specified logical, ontological, and other relevant considerations, it is concluded that in the very-long-run: (1) forward-directed time travel capacity is highly likely; and, (2) past-directed time travel capacity is likely. Four logically possible forward-directed, and four logically possible past-directed, types of (hypothetical) time machines are identified. Two different approaches (the "practical"; the "bi-temporal") are utilized in attempting to characterize the meaning of time travel. It apparently turns out that the concept of "embedded-subjective time" (i.e. the embedded-temporality of the human time-traveler, as distinguished from either merely-subjective time or literal-wristwatch time) is especially helpful in characterizing whether time travel did or did not occur in a particular circumstance.

Key words: Cryonics, Future, Future-technology, Many-worlds, Multiverse, Ontology, Suspended-animation, Transhuman

Introduction

To what extent may time travel be possible? Herein I consider this question and attempt to develop one plausible answer. I do not mean that other answers may not be plausible. I do not mean that my answer is necessarily correct. Indeed, I am neither a mathematician nor a physicist, so I am especially hopeful that those with mathematical-scientific expertise will critically examine my speculative schema and mutually dialogue with me about time travel. I would like to hear from other scholars as well, especially with reference to the ethics of time travel.

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Future-Directed Time Travel

We may begin by distinguishing between future-directed versus past-directed time travel. As we look at the matter based on what the late 20th-century and early 21st-century experts say, we find a strong consensus that future-directed time travel is possible. There is widespread agreement that sooner or later we will have the technical ability to build time machines that can take us into the far future. There is further widespread agreement that this ability is "overdetermined" in that there are (will be) at least two different technologies of future-directed time travel: suspended-animation and superfast-rocketry. Here, "suspended-animation" is the technique of suspending (preserving) a biological entity long-term and reviving it to "full" health or better ("enhanced" health). Many adult human persons today are alive and well due to their cryogenic suspended-animation in the 20th century when they were mere embryos; the mass media sometimes refers to these adults as first generation "test tube babies".

Another feasible time travel technology is that of advanced space travel technology (superfast-rocketry). Here, "superfast-rocketry" refers to an apparent fact, already tested, based on the relativity physics of Albert Einstein. Astronauts aboard a rocket traveling near the speed of light could travel into space and return to Earth. For example, from their point of view, they spend six weeks on vacation in space travel – but upon return to Earth they find that six centuries (not six weeks) have elapsed. This is sometimes called the "twins paradox" (one an astronaut, the other a homebody) – however today's scientists no longer consider it to be a paradox but a scientific fact.

So most experts agree that biological technology related to suspended-animation, and space technology related to superfast-rocketry, will advance to give us the technical ability to travel to the far future. Will these two kinds of time machines compete in the open marketplace? Be that as it may, many experts believe that one or both of these techniques may advance rapidly enough to allow some persons alive today (and still alive when the first time machines have been perfected) to travel to the far future.

Past-Directed Time Travel

A half-century ago, Robert Heinlein published a science fiction novel, *The Door Into Summer.*[1] The protagonist lived with his pet cat, Pete. On snowy winter days Pete would search their large house for a door into summer. (Pete believed that his master should be smart enough to outwit winter by constructing at least one door that would always lead into summer.) Anyway, the protagonist undergoes suspended-animation and travels to a point in the future where past-directed time machines exist. In this way one may travel in time to the future or to the past as one wishes.

What do today's time travel experts think of the Heinlein scenario? The experts say (see above) that future-directed time travel is the easy question; given enough time to perfect future-directed time technology (whether years or centuries), we should be able to do it. The hard question is whether past-directed time travel is possible and whether past-directed time machines could ever become possible and feasible for practical use.

First let's outline some "merely logical" alternative possibilities here. Until only a few decades ago, most all philosophers and scientists were agreed that past-directed

time travel was impossible. But today many experts do not believe that past-directed time travel is necessarily impossible; they generally find it a hard question to answer definitively. It seems that some (or perhaps much) physical theory remains yet to be invented and tested in the future (or perhaps in the far future).

Let's now look at the logical possibilities. Here is one way to formulate the alternatives with respect to past-directed time travel:

- Time travel is impossible.
- Time travel is possible but changing the past is impossible.
- Time travel is possible and changing the past is possible.

Time Travel Is Impossible

More than a decade ago, Stephen Hawking published his "chronology protection conjecture"[2] – namely, that the laws of physics conspire to prevent past-directed time travel on a macroscopic scale. Notice that it is only a "conjecture": I suppose Hawking wanted scholars to get on with serious work instead of wasting their time on wild speculation about classical (i.e. macro-level) time machines. Apparently most experts did not find Hawking's argument (such as it was) very convincing. (Or perhaps they simply found it too boring, not much fun!)

Time Travel Is Possible But ...

Many experts are willing to at least entertain the idea that time travel just might be possible. But many are unwilling to go further and think seriously about changing the past. One may argue that past-directed time travel is *not* logically impossible – but that changing the past *is* logically impossible. For example, movie-goers may interpret one of the Harry Potter movies this way: the protagonists (including Harry) travel into the past and interact with the past but do not change the past. Their travel into, and interaction with, the past "always was" part of the past! Another alternative here would have been to have the protagonists *not* interact with the past but simply passively observe it; this is sometimes called "time viewing" (rather than time travel).

Time Travel Is Possible And ...

Is it possible to evade or outwit the apparent inconsistency (logical impossibility) of "changing the past"? The answer is "yes": the "many-worlds" or "parallel-worlds" or "multiverse" theory (or theories or versions) does indeed allow time-traveling mathematicians, physicists, and philosophers to "have their cake and eat it too". For example, movie-goers may interpret the "Back to the Future" series of movies in just this way. In this interpretation of the parallel-worlds or many-worlds multiverse, going back to the past and changing it engenders a new timeline additional to the timeline from which the time-traveler came.

Related Logical Possibilities

Let me suggest three basic *existential alternatives* for humanity with respect to (past-directed) time travel:

- We do not reach Quasigodhood.
- We reach Quasigodhood but do not engender time-machines.
- We reach Quasigodhood and engender time-machines.

In addition, let me suggest the following *metaphysical perspective*:

- We can think in terms of something like personhood or (reflexive) mentality or Quasigodhood as potentially capable of engendering time-machines.
- We can think in terms of something like Nature or the temporal or the physical world as potentially capable of engendering time-machines.
- And we can think in terms of something like God or the eternal or the Platonic world as potentially capable of engendering time-machines.
- *Accordingly*: To the extent that there are or may be time-machines (if any), every time-machine is God-engendered, Nature-engendered, and/or Quasigod-engendered.

Almost all the experts say that even if a past-directed time-machine were possible, it could not be used to travel back in time to before the machine existed. Yet some interpretations of the many-worlds view would nevertheless seem to allow it. I believe Michio Kaku and Frank J. Tipler are multiverse experts willing to entertain the possibility of time travel back to times devoid of time-machines.

The Ontology of Time

Momentarily I will proceed to formulate my own time travel schema or ontology of time based in part on the following *three principles* (P1, P2, and P3):[3]

P1: I prefer to live in a world or multiverse in which free agents of good will are possible and in which they can eventually flourish as they attempt to enhance their capacity to pursue wisdom and respect persons.

P2: Almost any technology we can imagine which does not contradict the known laws of science will eventually become possible. (Others may also add: "And many things which contradict our scientific laws as presently constituted will also come to pass.")

P3: Our particular universe's past is short and almost non-existent compared to the potential reality of a very long and greatly enhanced future.

I believe *non-experts* informed by these three principles may be better predictors of *far-future* technological capacities than *experts* uninformed by the three principles. Notice here that we are *not* referring to predictions related to political developments, social changes, or near-future technologies. Likewise we are *not* referring to predictions accompanied by dates or timetables. Rather, we are simply referring to predictions of far-future technological capacities. "Our particular universe's past is short and almost non-existent compared to the potential reality of a very long and greatly enhanced future."

Experts such as research scientists often tend to be focused on the difficult puzzles and problems their experiments are designed to uncover or solve. The non-expert is not aware of the numerous barriers that would have to be overcome in order for their non-expert prediction ever to come true. If a highly focused research scientist is more likely to advance science than is a non-scientist, a non-scientist may be better than a scientist at predicting far-future technological capacities.

Karl Popper agrees with the common view that the future is not fully determined; even in principle the future cannot be reliably scientifically predicted in detail. But the past (since it is past) has been fully determined and thus in principle can be reliably scientifically retrodicted in detail. Karl Popper explains his interpretation of relativity physics this way: "Thus ... according to special relativity, the past is that region which can, in principle, be known; and the future is that region which, although influenced by the present, is always 'open': it is not only unknown, but in principle not fully knowable ... The predictions demanded by 'scientific' determinism must be interpreted, from the point of view of special relativity itself, as **retrodictions**."[4]

J. R. Lucas elaborates further: "The future is a touchstone for our attitudes to time and reality, to causality and freedom, to responsibility and creativity. If we believe that the past and present exist but not the future, except as some set of tenuous possibilities, then we begin to understand why the past is unalterable and the future open, and have a view of reality that accounts for the peculiar status of the present and our sense of time as becoming. It allows for freedom and responsibility and creativity, and since they cannot be undone or conjured out of existence, it acknowledges the everlasting significance of our deeds."[5]

A Time Travel Schema

If we put all of the above considerations together and attempt inference to a best explanation, I believe something like the *following time travel schema* or ontology of time results:

1. The past exists as an expanding fixed unity.
2. The present is the leading edge of the past as it expands.
3. The future is not yet fully determined/fixed.
4. The underdetermined future as it proceeds to become more nearly past (fixed) is influenced by the expanding fixed unity (the past), including by free agents of good will.
5. Sooner or later, barring catastrophe, it seems highly likely that

technology will advance so that the capacity for forward-directed time travel is possible.

6. Sooner or later, barring catastrophe, it seems likely that technology will advance so that the capacity for past-directed time travel is possible.

Eight Types Of Time Travel

Given my time travel schema above and the background considerations on which it is based, how may free agents of good will enhance their capacity to pursue wisdom and respect persons? Below I will specify the various types of hypothetical time machines according to function; in a later paper I hope to articulate potential harms and benefits of time travel. Without meaning to predict a timetable of invention, we will begin with the *merely presumptively* earlier (less difficult) technologies and work toward the *merely presumptively* later (more difficult) technologies.

Eight Types of Time Travel

I. Future-directed Time Travel

A. Suspended Animation

1. **Basic Biostasis**
2. **Advanced Biostasis**

B. Superfast Rocketry

3. **AOK Superfast Rocketry**
4. **EGC Superfast Rocketry**

II. Past-directed Time Travel

C. Non-branching Universe Time Travel

5. **Simple Time Viewing**
6. **Simple Time Travel**

D. Branching Multiverse Time Travel

7. **Complex Time Viewing**
8. **Complex Time Travel**

Time machines 1, 2, 3, and 4 seem "highly likely" and it also seems fair to say that (at least) time machine 5 or time machine 7 is "likely" – based on the *three principles* (P1, P2, P3 above). This categorization of hypothetical time machines into "eight" types (based on the time travel schema and background considerations above) is simply one way to formulate the matter. I hope readers will contact me with their own ideas about categorization. I will now briefly explain the eight categories.

Brief Explanation of the Eight Types of Time Machines

1. Basic Biostasis: Experimental long-term suspended animation
2. Advanced Biostasis: Perfected long-term suspended animation
3. AOK Superfast Rocketry: "Astronaut(s) OK" (AOK) near-light-speed rocketry
4. EGC Superfast Rocketry: "Extra-terrestrial Green-habitat Community(ies)" (EGC) near-light-speed rocketry[6]
5. Simple Time Viewing: Viewing the past without changing the past
6. Simple Time Travel: Interaction with the past without changing the past
7. Complex Time Viewing: Viewing the past that also changes the past (generates an additional timeline)
8. Complex Time Travel: Interaction with the past that also changes the past (generates an additional timeline)

What Is Time Travel?

You may have noticed that I have discussed "time travel" without explicitly defining it. Like Karl Popper, I believe that insisting on definitions is sometimes counterproductive – meaning that it is *sometimes* desirable *not* to define our terms if we want to make intellectual progress. (On the other hand, it is *sometimes* desirable to define our terms ... !) I think, per above, we have made some intellectual progress; presently I will look back and see if a definition (for "time travel") does or does not seem to emerge.

First I notice that I approached the matter from the standpoint of the human person (human persons as time travelers). But I might have asked, rather, to what extent time travel is possible for objects or entities other than humans. The time-traveling (non-human) object might have been a sub-atomic "particle"; or it might have been a book or the informational contents of a book or other *communication*. The time-traveling (non-human) entity might have been a transhuman person, or perhaps an extraterrestrial being or a planet or a galaxy or a *cluster of galaxies*. The types of time machines are open to alternative categorization – for example, depending in part on the *kind* of time traveler. However for present purposes, and as in the previous sections above, I will approach matters by assuming that the travelers are human persons and that we should consider more or less the eight types of time travel identified above.

Characterizing *past-directed* time travel seems relatively easy based on the fact that humans think of "normal" time as having an arrow pointed at the future. If I do "nothing" but sit at my desk for 5 minutes, I find myself automatically in the future 5 minutes later! In that sense, whether it takes a human person no time or 10 minutes or 30 minutes to travel 10 minutes into *the past*, the meaning of "time travel into *the past*" of (say) 10 minutes ago seems clear. But how shall we characterize the *future-*

directed time travel we have associated with suspended-animation and superfast-rocketry?

One possibility that seems to present itself as we try to characterize time travel, is that there are two differing times present at once (present together). There is *traveling-visitor* time and *place-visited* time. Our normal experience of time is that we are not engaged in time travel; when there is no difference between traveling-visitor time and place-visited time, we have no sense of participating in more than one time, we feel no temporal abnormality.

Will this bi-temporal distinction work as a characterization of time travel whether our travel is past or future directed? Let's try a thought experiment to see. We embed a clock in the body of the human time traveler (or perhaps the traveler is simply wearing a wristwatch): The embedded clock shows traveling-visitor time (time and date and year). Let us assume that the traveler wishes to travel 3 years into the past: The traveler leaves in the year 4444 and arrives in the year 4441. Since the traveler's embedded clock will read 4444 (or later), the bi-temporal idea seems to work for *past-directed* time travel.

Now let's try the same thought experiment but here the traveler wants to go (not from 4444 to 4441, but) from 4444 to 4447. If the traveler uses superfast-rocketry, then the embedded clock will mirror the "slower time" of the traveling astronaut: For example, it might show that the year is 4445 (depending on how fast the superfast rocket moves) instead of 4447. Thus the bi-temporal idea seems to work here too for *future-directed* time travel.

But what about suspended-animation? Here the answer is arguably more complicated. What method of suspended-animation is used? (Low-temperature or chemical-fixation or some other method? Or a combination of methods?) The time registering on the embedded clock when the sleeper awakes in the year 4447 will depend on the material make-up or construction of the embedded timepiece! Is it a waterproof watch? Is it sensitive to temperature or chemicals or heartbeat or brain activity or ... ? If we embed ordinary waterproof clocks in comatose animals, we will not find the bi-temporal distinction. On the other hand, the metabolism of some comatose animals may well differ, at least in our thought experiment, from their normal non-comatose metabolism. Anyway, some comatose humans, awakening after many years, might well have the feeling that they had time-traveled. (Indeed, the movie *Awakenings* was based on true events. It certainly seems their *subjective* experience, upon awakening, was akin to a sense of having time-traveled.) Likewise, a human being who wakes up in the morning after 7 hours of sound sleep may *claim* to have "time-traveled" 7 hours. But should we agree or disagree with the sleeper's assessment?

These considerations suggest, just possibly, that the bi-temporal idea may not work in these cases (sleep or coma or suspended-animation). Thus one alternative would be to declare suspended-animation *not* a form of time travel. Rather: "Suspended-animation is suspended-animation"; it is not time travel. But might there be here-relevant distinctions (or not?) between sleep, coma, and suspended-animation? Might the bi-temporal idea, if "properly" understood (interpreted), claim that suspended-animation (but not sleep or coma) is a form of time travel? The bi-temporal point is that of "bi-*temporal*-ity" rather than "bi-*wristwatch*-ity". Perhaps here we

should interpret time as embedded *temporal*-ity rather than as literal *wristwatch*-ity? Might this change our analysis and findings? Also: If it were possible even in principle to use sleep or coma to take us to the *far-future*, then in *that* context-of-use it would seem reasonable to refer to sleep or coma as a form of suspended-animation.

Let's engage in another thought experiment: Let's pretend we have the technical ability to put an animal or human in a state of sleep or coma (and, if we choose, revive it from sleep or coma) for as long as the entity shall live. But even with this considerable technical ability, the animal or human would nevertheless die after some decades!

Thus, even in principle, neither sleep nor coma has the ability to take us to the far-future. But suspended-animation shares with superfast-rocketry this astounding (far-future) capacity. Apparently neither sleep nor coma partake of the bi-temporal idea. But past-directed time travel and (future-directed) superfast rocketry clearly partake of the bi-temporal idea.

Our analysis has apparently been inconclusive (so far) as to whether (future-directed) suspended-animation does or does not partake of the bi-temporal idea. It is possible, if one so chooses, to define time travel in terms of the bi-temporal distinction. *If* one does so, one then has to *further* decide how to define or interpret "traveling-visitor" time (embedded time) and whether it can relevantly be said to differ from so-called "wristwatch" time.

At this point in the discussion let me interject an idea I believe enlightening, an insight (in some sense shared) by two futuristic mathematicians, Frank J. Tipler and Vernor Vinge. Perhaps there are occasions when we can manipulate (i.e. control or embed) our *subjective* state of mind so that as a practical matter it effectively defeats or outwits an unalterable ("undefeatable") *objective* fact. For example, let's say that it is certain and true that the world will end in the year 55555 (give or take 5 years). Now Tipler and Vinge believe that humans (or their offspring) can evolve or change so as to become Quasigods (my term). If the Quasigods are living in the year 55545, perhaps they should be concerned about the unalterable "near-future" event (that the world will end in the year 55555, give or take 5 years). But what if they have the ability of Quasigods to radically alter their subjective state of mind so as to think faster and faster? They can think as fast or as slow as they wish. In *practical* (!) effect this means that, *subjectively* speaking, they can always outwit the inevitable world's end so that it "never" arrives! (We may refer to this kind of controlled subjectivity as controlled embedded-subjectivity.)

So, to return to our discussion at the beginning of this section – we can now, if we wish, choose to characterize time travel as interpreted from a "*practical*" point of view. Thus we can say that both suspended-animation and superfast-rocketry are ways to "travel" to the far-future. (In the open marketplace of competition, suspended-animation may well have an early advantage.) Our two different attempts (the "*practical*" and the "*bi-temporal*" approaches) to characterize the meaning of the term "time travel" seem to give us similar results with respect to the "eight" types of time travel. (Too, it seems we have now come to identify bodily states like coma or sleep with mere-subjectivity rather than with time travel – and to identify suspended-animation with embedded-subjectivity and with time travel.)

The results of our "*practical*" approach are two-fold: (1) Due to our experience of the arrow of time, any technique allowing us (human persons) to travel into the past may be reasonably characterized as a time machine; and, (2) Any technique allowing us (human persons) to travel into the far-future, while allowing us to experience a relatively short period of time (or even an "instantaneous experience") on our way there (thus involving embedded-subjectivity), may also be reasonably characterized as a time machine. Moreover, the results of a "*bi-temporal*" approach are congruent with the two findings – if we choose to define *traveling-visitor time* as embedded-subjective time (i.e. embedded-temporality, as distinguished from either merely-subjective time or literal-wristwatch time).

Two Closing Quotations

> *What is time, then? As the future, it is possibility; as the past, it is the bond of fidelity; as the present, it is decision.*
>
> – Karl Jaspers[7]

> *Mankind lies groaning, ... deciding if they want merely to live, or intend to make just the extra effort required for fulfilling ... the essential function of the universe, which is a machine for the making of gods.*
>
> – Henri Bergson[8]

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Notes

1. Heinlein 1957.
2. Hawking 1992. Also See: <http://www.hawking.org.uk/lectures/warps3.html>; And Also See: <http://arxiv.org/abs/ gr-qc/9703024>.
3. Compare: Ettinger 2006.
4. Popper 1956 & 1991: 61.
5. Lucas 1989: 1.
6. It may be remarked that the distinction between AOK Superfast Rocketry and EGC Superfast Rocketry is not relevant within the context of this paper; if so, this would yield 7, not 8, types of time travel. Or it may be remarked that the (here-relevant) distinction between AOK Superfast Rocketry and EGC Superfast Rocketry should also be applied to the other types of time travel; if so, this would yield 14, not 8, types of time travel.

7. Jaspers 1932: 57.
8. Bergson 1932: 317.

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