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Mechanics of Time and its Paradoxes

D Sai Karthik

Time travel is a very popular and a fictitious idea that confuses the smartest. Many people say that time travel is possible and many people think it is impossible. In a way both of these sections of people are right. Let me explain. Before exploring the possibilities of time travel, Let us try to understand what 'Time' is.

The simple definition of time is "It is the measure of a change in a physical quantity or a magnitude used to quantify the duration of events." In simpler words it is a quantity used to measure the duration of different events.

Now let us understand what the term 'Time Travel' actually means. "Inevitably, it involves a discrepancy between time and time. Any traveller departs and then arrives at his destination; the time elapsed from departure to arrival (positive, or perhaps zero) is the duration of the journey. But if he is a time traveller, the separation in time between departure and arrival does not equal the duration of his journey" (Given by David Lewis). Let me explain it in simpler words. Let us take a time traveller 'A'. He sits in a time travelling machine. Let us say that the time inside the machine is 'Internal time' and the time outside the machine is 'External time'. Now 'A' wants to travel to 3 hours in the future. Let us say that we keep a clock outside the machine and 'A' has a wristwatch with him the whole time. During his departure, the external clock reads 1:00 PM and his wristwatch also reads 1:00 PM. After his arrival, the external clock now shows 4:00 PM but his wristwatch on the other hand shows 1:10 PM. What has happened here is that 3 hours of external time has elapsed but only 10 minutes of internal time has elapsed. This is what time travel is! A's duration of journey is just 10 minutes but the time elapsed externally is 3 hours. The duration of journey is not equal to the time elapsed externally. The same logic applies if A wants to travel to the past. A's arrival will be a time before his departure but internally the time would have changed for him.

On this note, Let me give a few examples of what it and isn't time travel - Time travel -

- A person sits in a time travelling machine in 2024. For the people who are observing externally it disappears. And then the time travelling machine suddenly appears for external observers in the year 2020(or 2028). But for the person inside the machine only 10 minutes have elapsed.
- A time traveller gets a hold of a special device and instantaneously travels forward or backward in time. Unlike the previous case there is no change in the internal time.
- A time traveller steps into an ordinary rocket ship (not a special time machine) and flies off on a certain course. At no point does she disappear or 'turn back in time' yet thanks to the overall structure of spacetime (as conceived in the General Theory of Relativity), the traveller arrives at a point in the past (or future) of her departure. (Compare the way in which someone can travel continuously westwards, and arrive to the east of her departure point, thanks to the overall curved structure of the surface of the earth.)
- A time traveller sits in a spaceship which travels faster than a light for a round trip. When he arrives back to Earth, very less time would have passed for him but thanks to special theory of general relativity a great deal of time would have passed back on earth.

Not time travel -

- A person is very tired and he sleeps. It might seem very less time has passed for him during the sleep but in reality the time elapsed externally is equal to the time elapsed internally.
- A person is in a coma. He wakes up after years. For him time seems to have barely passed but his body
- experienced all the time which has passed.
- A person is cryogenically frozen for a few years. He does not travel in time.
- A person departs from an airport at 10 AM on Monday and arrives at the destination at 9:30 AM despite the 2 hour travel time. This is just a time difference and not time travel.

This should have made it clear what time travel is. In fact there is no entirely satisfactory definition of 'time travel' in any literature. But many scientists and philosophers keep deliberating on what time travel is. Let me show you a few examples of these definitions. One of these is already discussed before which was given by David Lewis. Another definition of time travel that "One sometimes encounters in the literature (Arntzenius, 2006, 602)(Smeenk and Wüthrich, 2011, 5, 26) equates time travel with the existence of CTC's: closed timelike curves. A curve in this context is a line in spacetime; it is timelike if it could represent the career of a material object; and it is closed if it returns to its starting point (i.e. in spacetime—not merely in space)". Some authors (in philosophy, physics and science fiction) consider 'time travel' scenarios in which there are two temporal dimensions (e.g. Meiland (1974)), and others consider scenarios in which there are multiple 'parallel' universes—each one with its own four-dimensional spacetime (e.g. Deutsch and Lockwood (1994)). There are many interpretations of time and time travels given by many scientists and philosophers.

Our world if time travel could exist would be a four-dimensional manifold of events. Time would also be considered a dimension like the other spatial dimensions. Enduring things are timelike streaks: wholes composed of temporal parts, or stages, located at various times and places. Change is a qualitative difference between different stages—different temporal parts—of some enduring thing, just as a "change" in scenery from east to west is a qualitative difference between the eastern and western spatial parts of the landscape. Let me explain 'Temporal change' in

simpler words.Imagine if you had a fewbeliefs in your life. Youthen read a very goodphilosophical book whichchanges your previousbeliefs and you interpretlife in a different way. There will be a difference of opinion between two different temporal partsof you, the stage ofyourself before youstarted reading the bookand the stage where youfinish reading the book. A time traveller, like anyone else, is a streak throughthe manifold ofspace-time, a wholecomposed of stages located at various times and places.

Now, a curious question might be creeping into your mind. If time travelling could exist, then what can a time traveller do? You might perhaps think the answer to this question is "Anything he wants to". You might think a time traveller could right the many wrongs of history or change something ofthe past he might regret later on etc.But this would be wrong. The very description of the case involves a contradiction.Let me break it down to you. There exists only one version of the past. There cannot coexist two different versions of the past (One where a time traveller exists and one where he doesn't) in the same world. This means time travellers cannot do much in the past. He cannot even move a speck of dust in the past if it did not move at that particular time let alone righting the wrongs of history. But this does *not* mean that time travellers must be entirely powerless in the past, while they cannot do anything that did not actually happen, they *can* (in principle) do anything that *did* happen. Time travellers cannot change the past nor can they make it different from the way it was—but they can participate in it. Let me explain it to you with the help of an example. A time traveller wants to travel to the time of world war 2 (War between allies and axis powers). He wants to change the past and make the axis power win instead of the alliedpowers. He cannotaccording to the laws of physics, logic and laws of time travel do anything to make the axis powers win. He can however participate in the warand have an outcomewhich is the same if he did not travel in the past. Whatever he tries to do the allied power would win world war 2.

Let us look at a paradox of time travel. It is perhaps the biggest and the most contradicting paradox for time travel. Consider Tim. He hates his grandfather and has a murderous intent to kill him. But alas grandfather died in 1957 when Tim was a little boy. So he does years of rigorous research and builds a time machine to kill his grandfather. He goes to the shooting range to practise shooting and becomes the best shooter. He buys the best rifle that money can buy. He digs through old books to find out the routine of grandfather and studies them intensively. He finally goes to the past and books a room where grandfather will pass by.He makes sure everything is perfect. The gun is working, the doors are shut to prevent intruders, The gun is loaded andTim is in the best form ever. Practicallyspeaking, Tim can execute the murder flawlessly. Let us assume that there is no chaperone (A few authors and philosophers believe that there exists a chaperone or a time protector who wouldprevent any changes inthe past). What is to stop Tim from killing his grandfather? The forces of Logic! Tim cannot kill grandfather. But Tim has a loaded gun and has the ability to aim and pullthe trigger. By this argument Tim can kill grandfather. Tim can and cannot kill grandfather at the same time. Let me break it down to you. Let us consider an 'Original' 1957 where Tim is not a time traveller and a 'New' 1957 where Tim is a time traveller. Tim cannot killgrandfather in the original 1957 and Tim can kill grandfather in the new 1957. This means that Tim can and cannot kill grandfather in 1957. If Tim kills grandfather, Father would not have been born. Then even Tim would not have been born which means that Tim would not have time travelled. But Tim did time travel. Tim did anddid not time travel at the same time which is not possible. Since Tim didn't kill Grandfather in the 'original 1921, consistency demands that neither does he kill Grandfather in the 'new' 1921. Now the question might arise: How can Tim not kill grandfather if everything is in his favour? Well, the answer to this question is Tim will not be able to kill grandfather due to some commonplace reasons. Maybe, he slips and falls down or he gets interrupted or he gets distracted by somethingor his body fails to pull the trigger. Some might even say that the universe conspires against himand prevents him fromkilling grandfatherbecause nothing can change the past.

We have this seeming contradiction: "Timdoesn't, but can, because he has what it takes" versus "Tim doesn't, and can't, because it'slogically impossible tochange the past." I reply that there is no contradiction. Bothconclusions are true, and for the reasons given.They are compatible because "can" is equivocal(Lewis, 1976).Let me explain this. It is like saying If a time traveller visiting the past both could and couldn't do something that would change it, then there cannot possibly be such a time traveller. The most popular solution to this is given by Lewis himself. Broken down to the simplest form this is what it means. If something can happen itmust be compossible to certain facts. In this case, the situation where Tim can kill grandfather is compossible with many exclusive sets of facts. Some of the facts which are compossible are Tim having a loaded gun, his practice at the range, no presence of chaperone, gun working properly etc. Tim not killing grandfather is also compossible with many inclusive facts. Some of these are grandfather was alive in 1957 and grandfather having father and father in turn having Tim. Relative to these facts Tim cannot kill grandfather. Thus 'Tim can kill Grandfather' is true in one sense (relative to one set of facts) and false in another sense (relative to another set of facts)—but there is no single sense in which it is both true and false. So there is no contradiction here—merely anequivocation.

Another response is that of Vihvelin (1996), who argues that there is no contradiction here because 'Tim can kill Grandfather' is simply false (i.e. contra Lewis, there is no legitimate sense in which it is true). According to Vihvelin, for 'Tim can kill Grandfather' to be true, there must be at least some occasions on which 'If Tim had tried to kill Grandfather,he would or at least might have succeeded' is true—but, Vihvelin argues, at any world remotely like ours, the latter counterfactual is always false.

Think about correlated events in general. Whenever we see two things frequently occurring together, this is because one of them causes the other, or some third thing causes both. Horwich calls this the Principle of V-Correlation. If events of type A and B are associated with one another, then either there is always a chain of events between them or else we

find an earlierevent of type C that links up with A and B by two such chains of events. What we do not see is an inverse fork in which A and B are connected only with a characteristic subsequent event, but no preceding one. (Horwich, 1987, 97–8) Let me explain this with anexample. Let us say there is a person 'x' and a person 'y'. Both x and y go to the same shop. You might think that it is just a coincidence and you might be right. But if x and y go to the same shop on the same day for a year then there is a very high possibility that it isnot a coincidence. Thismight be due to extensive correlation (Maybe theyneed the same things, or the shop has a discount for only both of them, or the shop is nearby to both their houses) or due to a causal link (x might be deliberately copyingwhat y is doing). Now consider Tim trying to kill his grandfather. As we discussed it will not happen due tocommonplace reasons like he slips and falls on a banana peel, there might be some disturbances etc.

But now consider this run of ordinary occurrences.Whenever Tim tries to shoot someone drops abanana peel near his leg or whenever he pulls the trigger a bird flies in the path of the bullet. In general, there will be a correlation between the murder attempts and foiling occurrences such as the presence of banana peels—and thiscorrelation will be of the type that does not involve a direct causalconnection between the correlated events or a common cause of both. But extensive correlations of this sort are, as wesaw, extremely rare—so backwards time travelwill happen about as often as you will see two people visiting the same shop on the same day for a year *without* there being any causal connection between where one goes and where the other goes. The conclusion is not that time travel is impossible, but that we should treat it the way we treat the possibility of, say, rolling a die and getting the number '1' every time for a thousand times. As Price (1996, 278 n.7) puts it—in the context of endorsing Horwich's conclusion: "the hypothesis of time travelcan be made to imply propositions of arbitrarily lowprobability. This is not a classical reductio, but it is as close as science ever gets."

Let us now visit what is 'causal loops'. Imagine there is a scientist who created a time machine. After creating the time machine, he travels backin time and meets his younger self. Then herealises a strange encounter with someone when he was a child. This 'someone' had given him a book which in turn helped him in creating atime machine. He thenrealises that this'someone' is himself but from the future. Now he gets a sense of responsibility and doesthe same. He gives hisyounger self a notebook about the time machine. Now, the question is who invented the timemachine. It is not his older self as his older self had given him the book.

Then what is the answer to this question? The simple answer to thisquestion is simply 'noone'. It is not created by someone, the time machine just exists. The scientist has to keep doing this. The younger self builds a time machine in the future and then again gives a book to his younger self. This keeps happening for eternity. In order for the time machine to exist, there should be a loop continuing. Now imagineif this loop is somehow broken. What happens then? The time machine does not exist then. This is the reason why many scientists argue that backwards causation and backward loops do not exist and hence there is no such thing as time travel. Let's take a look at a few such examples.

There are two issues to consider here. First, does backwards time travelentail causal loops? Lewis (1976, 148) raises the question whether theremust be causal loops whenever there isbackwards causation; inresponse to the question, he says simply "I am not sure." Mellor (1998, 131)appears to claim apositive answer to the question. Hanley (2004,130) defends a negative answer by telling a time travel story in which there is backwards time travel and backwards causation, but no causal loops. Monton (2009) criticises Hanley's counterexample, but also defends a negative answer via differentcounterexamples.

Let us take a look at some views on time. Beforepeople used to research time travel to object to the possibility of it. Now, in modern physics we see a connection between time travel and metaphysics. Two most important questions of metaphysics are -

- Are the past, present and future equally real?
- Is there an objective flow or passage of time, and an objective now?

Let us first discuss the first question. Some views on the first question are as follows. Some people believe in eternalism. What is eternalism you may ask. It is the belief that present(now), past(before now) and future(after now) are all a part of reality. Nowism is the belief that only the present contains realobjects.

Now-and-then-ism is thebelief that only the present and past are realities but not thefuture.

Let us now take a look at the second question. Some views are asfollows. The *A-theory* answers in the affirmative: the flow of time and division of events into past (before now), present (now) andfuture (after now) areobjective features of reality (as opposed tomere features of our experience).

Furthermore, they are linked: the objective flow of time arises from the movement, through time, of the objective now (from the past towards the future). The *B-theory* answers in the negative: while we certainly experience now as special, and time asflowing, the B-theory denies that what is going on here is that we are detecting objectivefeatures of reality in away that corresponds transparently to howthose features are in themselves. The flow of time and the now are not objective features of reality; they are merely features of ourexperience. By combining answers to our first and second questions we arrive at positions on the metaphysics of time such as:

- The *block universe*view: eternalism + B-theory
- The *moving spotlight* view: eternalism +A-theory
- The *presentist* view:nowism + A-theory
- The *growing block* view: now-and-then-ism + A-theory.

Now let us take a look at views upon temporal objects.

Some people say that there exists three dimensions (three-dimensionalism) and some people say that there exists four dimensions (four-dimensi onalism). Let us first understand what these terms mean. Three dimensions are all of the three spatial dimensions whereas time is considered to be the fourth dimension. Let ussay that you see a tree in front of you. You then wait for a day and see thetree tomorrow again.

Now, three-dimensionalsim says that they both arethe same. But four-dimensionalism says that they both are different. Let us deep diver to understand what is going on. Three- and four-dimensionalists agree that (some) objects persist, but they differ over how objects persist.

According to three-dimensionalists, objects persist by *enduring*: an object persists from t_1 to t_2 by being wholly present at $t_1$and t_2 and every instant in between. According to four-dimensionalists, objects persist by *perduring*: an object persists from t_1 to t_2 by having temporal parts att_1 and t_2 and every instant in between.

Leibniz's Law says that if $x = y$ (i.e. x and y are identical—one and the same entity) then x and $y$have exactly the same properties. There is a superficial conflict between this principle oflogic and the fact that things change.

Three-dimensionalists and four-dimensionalists respond to this problem in different ways. Let us take an example. Supposethere is an apple kept in abox. When we check it after a few days the apple is found to be rotten. Now, the four-dimensionalist argue that they are the same but they are both a temporal part of the apple. The apple and the rotten version of the apple are both temporal parts of the apple.

Three-dimensionalists have several options. One is to deny that there are such properties as 'rotten' and 'not rotten': there areonly temporally relativised properties such as 'not rotten at time t'. In that case, while the apple at t_1 and apple at t_2 are the very same entity—the apple is wholly present at each time—there is no single property that this one entity both possesses and fails to possess: The apple possesses the property 'not rotten at t_1 ' and lacks the property 'not rotten at t_2'.

After reading so much about time and time travel you might wonder, 'if time travel does exist, then where are the time travellers?' This is a very valid question which troubles many scientists even now. There are a few possible explanations.

One possible explanation is to outright say that time travel does not exist. This is a weak explanation but it makes sense. Other explanations could be that time travel may be very expensive, dangerous or even rare in the future. Another explanation that is, according to me, the most valid one is that time travel was invented far in the future. And when it does get inventedthe current time we live in does not hold much significance, hence there are very less to none possibilities of findingtime travellers now.

My theory on TimeTravel -

Before I end the research paper I havea theory about time and time travel I would like to share.

This theory solves almost all the paradoxes and problems that scientists face while explaining time travel. Firstly, to understand this, let me pose this question. 'What is the universe?' There are no correct or wrong answers to this question because anything and everything you say or think exists in reality in this universe. I liketo define our universe as 'A particular arrangement of atoms.' A simple yet a complex definition.

There might be a question which arisesasking 'what if the universe had a different arrangement of atoms?" Then the answer to this would be the universe is a different one. Let us say a universe has an arrangement 'A'. Let us say there exists another universe.

How would you definethis universe? We would define this universe as "The universe that has an arrangement B." You might be thinking what the relation between this and timeis. You would be right in wondering so.

Imagine that a persontravels in time and goes to the past.

Originally the universe would have had a particular arrangement of atoms. But when the time traveller travelsto the past, He existsin the past. That means because of this the universe suddenly has a change in its arrangement of its atoms. This is due to the reason that the time traveller did notexist and when he does travel in time hesuddenly exists. You might be thinking what would happen insuch a case. My theory is that at the instant that the time traveller travels to the past and there is achange in the arrangement of the atoms, there is a creation of a new parallel universe.

This universe does not have any relation with the original one, i.e a change in the new universe does not mean that there would be a change in the original one. There seems to be many interpretationsof quantum mechanics. My favourite one is the many world interpretation of quantum mechanics. The many-worlds interpretation implies that there are most likely an uncountable number of universes. It is one of a number of multiverse hypotheses in physicsand philosophy. Many worlds interpretation views time as a many-branched tree, wherein every possible quantum outcome is realised. My theory is that the many worlds interpretation is the correct interpretation and there exists parallel universes created constantly by time travellers. This would solve the grandfather paradox. In this case, Tim does kill grandfather but ina parallel universe.

Tim does continue to exist as he is from the original universe where in the past grandfather exists. But in the new parallel universe, Neither Tim nor his father would ever exist. This would also explain why we see no time travellers.

References

[1] Baron, Sam and Colyvan, Mark, 2016, "Time enough for explanation", *Journal of Philosophy*,

[2] Benovsky, Jiri, 2011, "Endurance and time travel", *Kriterion*,.
[3] Berkovitz, Joseph, 2001, "On chance in causal loops", *Mind*.
[4] Black, Max, 1956, "Why cannot an effect precede its cause?", *Analysis*.
[5] Brier, Bob, 197 3, "Magicians, alarm clocks, and backward causation", *Southern Journal of Philosophy*
[6] Carlson, Erik, 2005, "A new time travel paradox resolved", *Philosophia*,
[7] Craig, William L., 1997, "Adams on actualism and presentism", *Philosophia*,
[8] Deutsch, David and Lockwood, Michael, 1994, "The quantum physics of time travel", *Scientific American*,
[9] 2001, "Causal loops and the independence of causal facts", *Philosophy of Science*,
[10] 2003, "The coincidences of time travel", *Philosophy of Science*,
[11] Dwyer, Larry, 197 7, "How to affect, but not change, the past", *Southern Journal of Philosophy*.
[12] Earman, John, 1995, *Bangs, Crunches, Whimpers, and Shrieks: Singularities and Acausalities in Relativistic Spacetimes*, New Y ork: Oxford University Press.
[13] Paradoxes of Time Travel (By David Lewis),
[14] Holt, Dennis Charles, 1981, "Time travel: The time discrepancy paradox", *Philosophical Investigations*,
[15] Lewis, David, 197 6, "The paradoxes of time travel", *American Philosophical Quarterly*,
[16] Loss, Roberto, 2015, "How to Change the Past in One-Dimensional Time", *Pacific Philosophical Quarterly*,
[17] Luminet, Jean-Pierre, 2011, "Time, topology, and the twin paradox", in *The Oxford Handbook of Philosophy of Time*, Craig Callender (ed.), Oxford: Oxford University press doi:10.1093/oxfordhb/9780199298204.003.0018
[18] Time Travel and Time Machines Chris Smeenk and Christian Wuthrich Forthcoming in C. Callender (ed.), Oxford Handbook of Time, Oxford University Press.
[19] Markosian, Ned, 2004, "Two arguments from Sider's *Four-Dimensionalism*", *Philosophy and Phenomenological Research*,
[20] Recent work on time travel (by John Earman),
[21] Markosian, Ned, 2020, "The Dynamic Theory of Time and Time Travel to the Past", *Disputatio*,
[22] Maudlin, Tim, 2012, *Philosophy of Physics: Space and Time*, Princeton: Princeton University Press.
[23] Meyer, Ulrich, 2012, "Explaining causal loops", *Analysis*,
[24] The Theoretical Basis and Feasibility of Time Travel Meining Du Bachelor of Science, The University of HongKong, Hong Kong, 99907 7 , China,
[25] Ney, S.E., 2000, "Are grandfathers an endangered species?", *Journal of Philosophical Research*, .
[26] Sider, Theodore, 2001 , *Four-Dimensionalism: An Ontology of Persistence and Time*, Oxford: Clarendon Press.
[27] Time Travel (By Stanford encyclopaedia of philosophy) *First published Thu Nov 14, 2013; substantive revision Fri Mar 22, 2024. https://plato.stanford.edu/entries/time-travel/*,
[28] 2002, "Time travel, coincidences and counterfactuals", *Philosophical Studies*,
[29] 2005, "Travelling in A- and B- time", *Monist* (Special Issue on Time Travel),
[30] Simon, Jonathan, 2005, "Is time travel a problem for the three-dimensionalist?", *Monist* (Special Issue on Time Travel),
[31] 2011, "Inconsistency in the A-theory", *Philosophical Studies*, 156: 231–47 .
[32] 2015, "Why time travellers (still) cannot change the past", *Revista Portuguesa de Filosofia*, .
[33] 2017 , "I'd do anything to change the past (but I can't do 'that')", *American Philosophical Quarterly*,
[34] van Inwagen, Peter, 2010, "Changing the past", in *Oxford Studies in Metaphysics* (Volume 5), Dean W. Zimmerman (ed.), Oxford: Oxford University Press,
[35] Vihvelin, Kadri, 1996, "What time travellers cannot do", *Philosophical Studies*, .
[36] 2010, "What time travellers may be able to do", *Philosophical Studies*,

Author Profile

D Sai Karthik
Author's email address: dsaikarthik24@gmail.com
Author's age - 16

Please feel free to reach out to me via the given email address if you liked the paper or want to talk about it.