IS TIME TRAVEL POSSIBLE?

ALISON FERNANDES
TRINITY COLLEGE DUBLIN
2019
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel *conceptually* possible?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel *conceptually* possible?
   - Is time travel compatible with the nature of time?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel *conceptually* possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?

2. Is time travel *conceptually* possible?
   - Is time travel compatible with the nature of time?
   - Does time travel lead to paradoxes?

3. Is time travel *physically* possible?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel conceptually possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
3. Is time travel physically possible?
WHAT IS TIME TRAVEL?

• Is it changing your temporal location as time goes on?
WHAT IS TIME TRAVEL?

• Is it changing your temporal location as time goes on?
• Then time travel is prevalent and unavoidable.
WHAT IS TIME TRAVEL?

• A ‘discrepancy between time and time’ (Lewis)
• A journey where a different amount of time passes for the traveller (their ‘personal time’), and for those in the surrounds (‘external time’).
• Not just that one’s experience of time changes, but all the processes we take to measure time.
• https://www.youtube.com/watch?v=M0qR7BiWJE
WHAT IS TIME TRAVEL?

- The ‘distance’ between two points can be different, depending on the path you take.
WHAT IS A TIME TRAVELLER?

• How do we distinguish between someone travelling in time, and someone being destroyed and a different person created?

• Appeal to what usually makes us the same person across time: causal connection.

• Time travel needn’t involve people, but is usually taken to involve at least objects.
WHAT IS TIME TRAVEL?

- When you travel to the future, you’re still causally connected.
- When you travel to the past, you’re still casually connected.
- So backwards time travel requires *backwards causation*.
WHAT IS TIME TRAVEL?

• But doesn’t time travel require *branching* time lines?
• Or *changing* the past from being one way to being another way?
WHAT IS TIME TRAVEL?

Branching:

• Don’t we want to time travel to our actual past or future—rather than to a different ‘parallel’ past or future?
WHAT IS TIME TRAVEL?

Changing the Past:

- Backwards time travel has to involve *affecting* (causing) events in the past.
WHAT IS TIME TRAVEL?

Changing the Past:

• Backwards time travel has to involve *affecting* (causing) events in the past.

• But it needn’t involve *changing* the past.
WHAT IS TIME TRAVEL?

Changing the Past:

• Backwards time travel has to involve *affecting* (causing) events in the past.

• But it needn’t involve *changing* the past.

• In a sense, the time traveller was ‘always already’ there to begin with.
12 Monkeys

- 1990: James Cole is born.
- Young JC’s childhood
- 1995: Adult JC, aged 40, arrives from the future.
- Adult JC hangs around.
- 1995: Adult JC dies
- Young JC grows up
- 2030: Adult JC is sent back to 1990.
12 Monkeys

- 1990: James Cole is born.
- Young JC’s childhood
- 1995: Adult JC, aged 40, arrives from the future.
- Adult JC hangs around.
- 1995: Adult JC dies
- Young JC grows up
- 2030: Adult JC is sent back to 1990.

Back to the Future

- 1955: Marty’s parents meet.
- 1970: Marty born
- 1955: Marty accidentally prevents his parent’s meeting.
- 1955: Marty’s 1985 birth starts to fade from existence.
- 1955: Marty gets his parents to meet
- 1985: Marty returns to future to find his parents happier than they originally were.
WHAT IS TIME TRAVEL?

Inconsistent time travel stories imply either:
WHAT IS TIME TRAVEL?

Inconsistent time travel stories imply either:

• Logical contradictions
  
  Time travel is then impossible
WHAT IS TIME TRAVEL?

Inconsistent time travel stories imply either:

- **Logical contradictions**
  
  Time travel is then impossible

- **Multiple dimensions of time**
  
  As with branching, we can never make it back to the actual past that we came from.
WHAT IS TIME TRAVEL?

1. What is time travel?

A journey where the time difference along the time travel route (‘personal time’) is different from the time distance in the surrounds (‘external time’).
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel *conceptually* possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
3. Is time travel *physically* possible?
IS TIME TRAVEL CONCEPTUALLY POSSIBLE?

- Is time travel possible, given what time travel, time, and causation have to be like (given the meanings of those terms).
- Closely related to whether time travel is *logically* or *metaphysically* possible.

- We’ve already seen that time travel allows for *consistent* stories.
FIRST WORRY: THE NATURE OF TIME

Time passes, or flows, forwards at a constant rate.

Passing time argument against time travel:
1. If time travel were to take place, time would have to pass differently for different people.
2. It is not possible for time to pass differently for different people.
3. So time travel is impossible.
THE NATURE OF TIME

Response:

• Time doesn’t pass!

• Time’s *seems* to flow or pass, because different things appear ‘present’ to us at different times. What we can influence and what we can’t keeps changing.

• But that’s compatible with time seeming to flow or pass differently from different people’s perspectives.
THE NATURE OF TIME

Time has an in-built direction.

*Direction of time argument:*

1. If backwards time travel were to take place, time would have to be directed backwards.
2. It is not possible for time to be directed backwards.
3. So backwards time travel is impossible.
First Response:

- Time *doesn’t* have an in-built direction.
- There are asymmetries in some relations in time (causation, laws, entropy) and how things are arranged in time (big bang).
- But no ‘intrinsic’ asymmetry in time itself.
THE NATURE OF TIME

Second Response:

• Even if there is an intrinsic asymmetry in time itself at our world, it’s conceptually possible to have time without this asymmetry.
THE NATURE OF TIME

Third Response:

- Even if time always goes *locally* forwards, time still might loop back along itself.
- So by travelling a particular path in time, you can end up prior in time to when you started: backwards time travel.
THE NATURE OF TIME

*Direction of causation argument:*

1. If backwards time travel were to take place, causation would have to go backwards.
2. Backwards causation is impossible.
3. So backwards time travel is impossible.
THE NATURE OF TIME

Response:

- Backwards causation is possible (even if it doesn’t happen).
- Or at least nothing in the nature of time or causation seems to rule out cases where causes come after their effects (in some temporal dimension).
- Remaining arguments against backwards causation are no different from the next arguments against (backwards) time travel.
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel conceptually possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
3. Is time travel physically possible?
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel conceptually possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
3. Is time travel physically possible?
SECOND WORRY: PARADOXES

General form of Paradox Arguments

1. Backwards time travel implies paradoxes—logical contradictions that can’t be avoided.
2. Paradoxes are impossible!
3. So backwards time travel is impossible.
PARADOXES

Asimov:

‘The dead giveaway that true time-travel is flatly impossible arises from the well-known “paradoxes” it entails. The classic example is “What if you go back into the past and kill your grandfather when he was still a little boy?” …So complex and hopeless are the paradoxes…that the easiest way out of the irrational chaos that results is to suppose that true time-travel is, and forever will be, impossible’. 
Lewis: ‘Consider Tim. He detests his grandfather, whose success in the munitions trade built the family fortune that paid for Tim's time machine. Tim would like nothing so much as to kill Grandfather, but alas he is too late. Grandfather died in his bed in 1957, while Tim was a young boy. But when Tim has built his time machine and traveled to 1920, suddenly he realizes that he is not too late after all. He buys a rifle; he spends long hours in target practice; he shadows Grandfather to learn the route of his daily walk to the munitions works; he rents a room along the route; and there he lurks, one winter day in 1921, rifle loaded, hate in his heart, as Grandfather walks closer, closer,…’
PARADOXES

‘Self-defeating causal loop’. It seems that if Tim succeeds at killing his young grandfather, Tim’s parent won’t be born. So Tim himself will never come to be. So he will both exist and not exist: Contradiction!

First Grandfather Paradox Argument

1. If time travel were possible, Tim would be able to kill his young grandfather.
2. If Tim were to kill his young grandfather, Tim both would and would not exist. Contradiction!
3. So time travel is impossible.
PARADOXES

- That argument was invalid.
- Even if Tim is *able* to kill his grandfather, this doesn’t mean he does.
- To avoid the contradiction, and for the story to be consistent, it simply needs to be the case that Tim *doesn’t* succeed at killing his young grandfather.
- Time travel does not imply the existence of self-defeating causal loops.
PARADOXES

• Nor do we need ‘Guardians of the Galaxy’ to safeguard the timeline of the universe.

• Tim will fail ‘For some commonplace reason. Perhaps some noise distracts him at the last moment, perhaps he misses despite all his target practice, perhaps his nerve fails, perhaps he even feels a pang of unaccustomed mercy.’ (Lewis)
PARADOXES

• But aren’t these coincides needed to ensure Tim’s failure really unlikely? Don’t they show that time travel is at least improbable? (Horwich, Price)

• **Wheeler-Feynman**: Wheeler, J. and Feynman, R. 1949. ‘Classical electrodynamics in terms of direct interparticle action’

• Introducing time travel regions can *change* what the expected behaviour is.

• **Maudlin and Arntzenius**: Stanford Encyclopedia of Philosophy, ‘Time Travel and Modern Physics’
PARADOXES

• It’s tempting to think that if time travel were possible, we could change the past, and make it otherwise than it was—and that this would lead to a paradox.

• But thinking we can change the past from what it was a fallacy: the ‘Second Time Around Fallacy’ (Smith)

• There’s only one way the past goes, just as there’s only one way the future will happen to go.
PARADOXES

- Does time travel imply strange shackles on the time traveller?
- If time travel would imply that we’re not free, and we know that we would be free, then isn’t time travel impossible?
PARADOXES

Second Grandfather Paradox Argument

1. If time travel is possible, Tim can kill his grandfather.
2. But Tim can’t kill his grandfather—if he did, a contradiction would be true.
3. Tim can kill his grandfather and Tim can’t kill his grandfather. Contradiction!
4. So time travel is impossible.
LEWIS’ SOLUTION

• The argument ‘equivocates’ by using ‘can’ in two senses.
• Tim *can* kill his grandfather in one sense: when we hold fixed what we ordinarily do when evaluating abilities. (If Tim were to succeed, he’d turn out not to be the grandson.)
• Tim *can’t* kill his grandfather in another sense: when we hold fixed the fact that Tim *doesn’t* in fact succeed.
• Just because Tim doesn’t happen to succeed, doesn’t mean he wasn’t able to, in any ordinary sense. We often don’t succeed at things we can do.
PARADOXES

• Lewis’ solution shows that contradiction can be avoided: we just have to evaluate a time traveller’s ability in the same way.
• But does it mean time travel puts no limits on our freedom?
• Debate continues.
• Some (Vihvelin, Rennick, myself) argue that there are limits.
• We can no longer presuppose an ‘open future’ when causal asymmetry is broken.
• But while time travel may be strange, none of this implies that it is impossible.
IS TIME TRAVEL CONCEPTUALLY POSSIBLE?
IS TIME TRAVEL CONCEPTUALLY POSSIBLE?

Yes
IS TIME TRAVEL POSSIBLE?

1. What is time travel?
2. Is time travel conceptually possible?
   • Is time travel compatible with the nature of time?
   • Does time travel lead to paradoxes?
3. Is time travel physically possible?
IS TIME TRAVEL PHYSICALLY POSSIBLE?

- According to General Relativity, we time travel all the time!
- Less time passes for you (time ‘slows down’) when you move faster relative to a ‘stationary’ observer.
- Less time passes for you (time ‘slows down’) when you travel closer to a gravitational body.
- To stay young, travel really fast close to a black hole…
IS TIME TRAVEL PHYSICALLY POSSIBLE?

INTERSTELLAR
IS BACKWARDS TIME TRAVEL PHYSICALLY POSSIBLE?
IS BACKWARDS TIME TRAVEL PHYSICALLY POSSIBLE?

• There are solutions to Einstein’s Field Equations that allow for ‘Closed Timelike Curves’.
IS TIME TRAVEL PHYSICALLY POSSIBLE?

- Some scientists think solutions like this shouldn’t be allowed. So they look to add restrictions to the form the solutions can take.
IS TIME TRAVEL PHYSICALLY POSSIBLE?

Hawking:

‘…travel into one's past…would seem to give rise to all sorts of logical problems, if you were able to change history. For example, what would happen if you killed your parents before you were born. It might be that one could avoid such paradoxes by some modification of the concept of free will. But this will not be necessary if what I call the chronology protection conjecture is correct: *The laws of physics prevent closed timelike curves from appearing*.'
IS TIME TRAVEL PHYSICALLY POSSIBLE?

• No compelling arguments have been found against the conceptual possibility of time travel.

• If closed timelike curves and other forms of time travel are ruled out, it will have to be on other (plausibly scientific) grounds.

• Cf. Entropy, limits on initial conditions
WHERE ARE THE TIME TRAVELLERS?
WHERE ARE THE TIME TRAVELLERS?

WHAT DO WE WANT?
TIME TRAVEL
WHEN DO WE WANT IT?
IT'S IRRELEVANT!
CONCLUSION

• Time travel is (at least) conceptually possible.
• Even if time travel is physically impossible, it’s possibility can’t be ruled out on purely philosophical grounds.
• Understanding time travel helps us think about the nature of time, and the links between time, causal asymmetry, and freedom.
FURTHER READING

- Lewis, David. 1976. ‘The Paradoxes of Time Travel’. *American Philosophical Quarterly*
- Heinlein, Robert A. 1959. ‘All You Zombies’. In *All You Zombies and Other Stories*.
- Movies: *12 Monkeys*, *Bill and Ted’s Excellent Adventure*, *Predestination*, *Arrival*, *Harry Potter and the Prisoner of Azkaban*
- Fernandes, Alison. Forth. ‘Freedom, Self-Prediction and the Possibility of Time Travel’ *Philosophical Studies*.
- Carroll, Sean. 2010. *From Eternity to Here: The Quest for the Ultimate Theory of Time*.