Summary
Video: Summary of Lecture 4

1:32 / 1:32 1.50x

but we made some progress.

It's tempting to think that when Bruno travels back

in time to kill grandfather and fails, he does not act freely.

But we have seen that arguing for such a claim

is definitely not as easy as one might have thought.

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Some comments on the "Time Travel" week

discussion posted 3 days ago by **Jimbof**

Some comments on the "Time Travel" week

We begin with a definition on consistency stating for any particular time "t", we can't coherently say certain element "e" can be in different states. Therefore George McFly cant be happy and unhappy, or a particle can't be in a "paradoxical path" and avoiding that same "paradoxical path".

With this definition we only allow Time Travel stories where the described states do not incurr in any such contradiction.

The main problem is that the mere presence of a new element in any given scenario causes state changes.

If I travel to the past and buy some company shares, then I bury them in a hole and recover them after I travel back to my future, I'm also changing certain previously existing states in the same time line, as for instance the ownner of those shares, probably the value of them, not to talk the impact of buring something in a hole (impact in bugs and bacteries living there or in the surroundings, etc), or changes in molecualar states due my body absorbing photons who were absorbed by those molecules in the first same timeline (molecule "A" was in a excited state before I decided to travel to the past, then it changed to a non-excited state because I absorved the photons causing its excitation).

Therefore an strict applycation of this principle makes time travel imposible!. Yet we have being dicussing ways of making sure this principle is respected.

Also we have introduced concepts as the "Control Hypothesis" but allowing only one intepretation. By "acting otherwise" we have considered only the "final result" derived from our actions and other's actions. For instance, Susan decides to take the train, she takes her luggage with her to the station, but as the trains has being sabotaged it won't travel to Alaska and Susan ends up having breakfast in New York. So we say her "act" is having breakfast in New York and she was not in a position to "act" otherwise, so had she decide to go have breaksfast in New York from the beginning she would have been not free to choose so.

I find this interpretation of the Control Hypothesis wrong, beacuse it Is not about what happens in the end but about our decisions and actions.

Susan actually is free to decide what to do, another question is if she can get the final desired outcome just by deciding and acting, as there might be external influences (like Susan's enemy) affecting the final outcome. The given interpretation implies you are free only if you have the power to make your wishes come true. A question of power, not of will. I don't think the "Control Hypothesis" is saying this.

Let's say I check my map and at somepoint I'm not sure if I have to turn left or right in order to get to my destiny. I freely decide to turn rigth, but then I find there's a policeman saying there's and obstacle ahead so I have to un-walk my steps and turn left in the previous point. Is the "Control Hypothesis" saying I wasn't I free when I deciced to turn right? I don't think so. Does the "Control Hypothesis" mean that I was free in selecting where to turn only if I can actually impose my will to the policeman and keep my way no matter what? I don't understand that from the "Control Hypothesis definition".

My point is then the "Control Hypothesis" is not saying that, not at least by what I understand from its definition in the lecture.

While I don't agree with the way some ideas have been introduced and some conclusions have been reached, I am enjoying this "Time Travel" week very much due the way I find my thoughts differ from some points, and due I have been motivated to think more deeply on these subjects.

What honestly I dont' like is some of this points have to be accepted almost as a faith dogma if you want to correctly answer the Homework problems. For me this is not a problem as I take Homework problems as learning exercises, but if I get in someone else's shoes I just don't think it is fair.

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1 response

Cosmo_Grant (Staff)
2 days ago

Thanks for the thoughtful feedback, Jimbof.

Could you clarify which homework problems you have in mind with your last point? We hope to have designed homework problems which do not require taking on faith any controversial points.

You say: "Therefore a strict application of this principle makes time travel impossible!. Yet we have being discussing ways of making sure this principle is respected."

I'm not sure that a strict application of the principle does make time travel impossible. Time travel does not, it seems to me, require that a contradiction be true at a particular point in time. Take the toy model, for example. In that model, contradictions are never true at any particular point in time, yet time travel is possible in the models, as we discussed.

Perhaps the question you have in mind is: Given a complete history of a world, how do we tell whether or not time travel has occurred? After all, given any history, it seems we can always account for that history in two ways: (a) by postulating a particular set of laws and taking some objects to go back in time; (b) by postulating a different set of laws and never taking any objects to go back in time. So no matter what the history is, we are never forced to conclude that time travel has taken place. We can always account for the history while assuming that no time travel takes place.

Take the toy model, for example. Suppose you weren't told how the toy model works but were just given a complete history of what goes on in the toy model and then had to infer the laws. You would have at least two options: (a) postulate the laws given in the text and take some particles to sometimes go back in time; (b) postulate a more complicated set of laws and never take any particles to go back in time.

So how do we tell which option is right? Well, I have no good answer to that question. Here's one potential rule of thumb: if the laws we have to postulate assuming *no* time travel are much more complicated than the laws we have to postulate assuming there *is* time travel, that's reason to think the world does exhibit time travel.

So I don't know, in general, how we decide which option is right: *this* set of laws *with* time travel, or *that* sets of laws *without* time travel. But it doesn't really worry me. Why not? Because we face these difficult choices all the time, not just when thinking about time travel. Given any evidence, there are typically multiple theories consistent with that evidence. There's no easy way to tell which theory is correct. You just do the best you can. The decision between *this* set of laws *with* time travel, or *that* sets of laws *without* time travel, is just another instance of this phenomenon.

Thanks for your reply Cosmo.

I plan to comment on specific homework problems after the due date is reached, as I'm afraid if I comment now on this I may provide clear tips on the right responses!

Regarding the consistence principle: we say George McFly can't be happy and unhappy, poor and rich, at the very same time, so if we travel in time and then back, and we see such state changes, the story in inconsistent and that kind of time travel is rejected. So we consider "acceptable" only time travels where states don't change. In other words, for any given pair "moment/state", this pair is constant. It can't be changed.

My point is if we generalize this principle to any state at any time, then time travel is

impossible because our mere presence when we travel back in time will change some pairs "moment/states" therefore causing an inconsistency. For instance just by being there some photons will impact in us, they won't be the cause of whatever state change they caused before when we didn't travel in time. So there we have inconsistencies, so we can't be there, so for us time travel is impossible.

In other words, How is it possible to suddenly "appear" at any given moment without causing state changes? Consider the case: "He was't there / He was there", this is a basic inconsistency, more even than "He was there poor and unhappy / He was there rich and happy".

In the other hand with this definition of consistency we are implicitly defining time, something in the line:
"A ordered sequence of related moments and states so strongly associated that once we have and state at any given time it can't be changed".
Or maybe: "A ordered sequence of "tick" elements, associated to the occurrence of events (change of states), where "ticks" and states, once determined, become linked and can't change."

Forgive my sloppiness in the definition of time, it just shows how hard is to accept such a definition of consistency, based on the nature of time, while time itself is not defined for that purpose. So in order to advance with the "Time Travel" discussion I have to accept the consistency principle as somehow dogmatic.

Can we reach to a similar conclusion using the "Toy Model" as reference? Regarding this you comment:
"...Take the toy model, for example. In that model, contradictions are never true at any particular point in time, yet time travel is possible in the models, as we discussed."

I can't agree with you on this. If we compare figure 2 and figure 3 from the text on the "Toy Model", in figure 2, particle "A" in point "a" prevents itself from entering the "paradoxical path". So in point "a" we have an "inconsistent" state for "A", as it is moving both right and left.

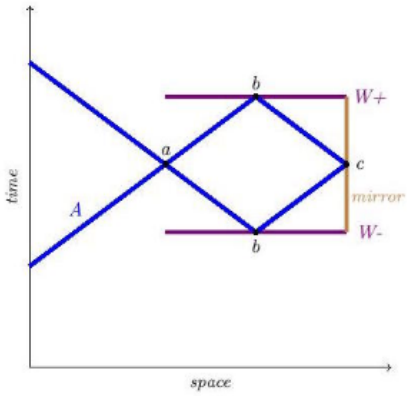
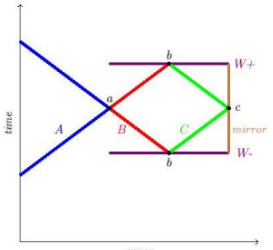


Figure 2. Particle A is prevented from entering the wormhole region by a future version of itself.

In figure 3 we build an alternative situation where there are other particles preventing "A" from entering the "paradoxical path", and doing so we have eliminated the "inconsistency" for "A" in point "a".



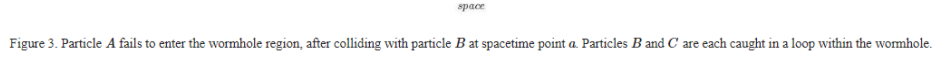


Figure 3. Particle A fails to enter the wormhole region, after colliding with particle B at spacetime point a. Particles B and C are each caught in a loop within the wormhole.

So in figure 2 "A" travels in time, but generates an inconsistency. In figure 3 "A" doesn't travel in time, particles "B" and "C" both do. Notice that had we chosen only particle "B" as the only particle preventing "A" from getting into a "paradoxical" path, we would have gotten another inconsistent situation in W- "b", as there "B" would be moving to the left and to the right at the same point. So the election of two particles "B" and "C" in the alternative model is not casual, it is a solution avoiding inconsistency.

So we have postulated 2 different situations and both prevents "A" from entering the wormhole + mirror system. The main problem with first alternative is the inconsiostency for "A" in "a", the main problem with the second is it requires further development of the "Toy Model" features (1) (more on this later).

At first glance it seems like the second alternative allows time travel. In fact it is based on particles "B" and "C" travelling in time! However, for any particle "A" outside the wormhole + mirror system it is not possible to travel in time, as it is always prevented. IOW, in this case for any particle out of the wormhole system time travel is not possible.

Does the first alternative allow time travel?, becuase it also prevents "A" from entering the wormhole system. It can allow time travel in different ways:
- If we define time as "manifolded", something similar to what we do in complex analysis when we define "cuts" (i.e.: along the 0 - Pi line). In this case we don't transform this in traveling to another reality so our family would miss us in the origin reality, we are moving reality (maybe only locally?) to another "fold". A crucial point here is particle "A" can "feel" it, or in other words "A" knows it has travelled in time.
- If we define pairs of "moment/states" as a superposition of states being determined when all influencing elements converge, or even being dinamycally determined: under some conditions we can move right, under some others we can move left, and loops of changing conditions are allowed. The crucial point here is we need some "information transport mechanism" so "A" can know it has travelled in time, otherwise we are in the same situation as before with the consistency principle.

Of course this definitions bring their own problems with them, and my intuition is they also make time travel impossible eventually, but we haven't discussed nothing like this, we just begun with the consistence principle so pairs of moments/states are written with fire on stone, to put it so. I would have appreciated a comment saying we are going to consider time travel only under the "consistency premise" due this or that reason (i.e.: lack of time, scope of the course, etc) (2).

Regarding (1) I like your approach of trying to infere the laws from what we observe: a particle "A" sort of "rebounding" away when it approaches the wormhole. In another post I made some observations on how the explanation given in the lecture with those 2 extra particles (figure 3) requires answering some questions. You may read my post ""Doesn't the Toy Model implies our consistence definition is wrong?", although I'm going to quote here the relevant points.

Here you say:
"...You would have at least two options:
(a) postulate the laws given in the text and take some particles to sometimes go back in time;
(b) postulate a more complicated set of laws and never take any particles to go back in time."

What I say in my post is about how the explanation including new different particles

(figure 3) would require further development of the model, because from my point of view that explanation is similar to what you say in b) with the difference being: in the text there are particles traveling in time. Quoting myself from that post:
"A possible explanation should requiere some sort of field theory on the "wormhole + mirror" system, including the existence of a "mediating particle" (the "wormhole boson" for instance), and a wave function expression describing the interaction between "A" particles type and "wormhole" particles. In such a way we could have an explanation on how any particle approaching a "wormhole + mirror" system interacts with the field associated to said system, and how those "system" particles are in a quantum state which is determined only when an interaction occurs."

I say this because the explanation including those new particles transforms the "wormhole + mirror" system in a sort of "black box" as experienced by "A", so putting us in the position of your option b).

Please don't misunderstandme as I find option b) completely legit!, but as we are talking about time travel, let's assume we are going to consider solutions only related to time travel happening (in a dogmatic way LOL!), in that case and from what we see comparing figure 2 and 3, wouldn't be legit to doubt the consistency principle?

This takes me back to (2), and the way the principle has been used alerts my "phylosophycal-amateur" senses. BTW I feel something similar about the interpretation given in the lecture to the "Control Hypothesis".

Lastly I agree 100% with you on how we decide which theory is right.

posted a day ago by **Jimbof**

> I plan to comment on specific homework problems after the due date is reached, as I'm afraid if I comment now on this I may provide clear tips on the right responses!

Ah, right. I'd forgotten this homework due date hadn't passed yet. Thanks for waiting.

> My point is if we generalize this principle to any state at any time, then time travel is impossible because our mere presence when we travel back in time will change some pairs "moment/states" therefore causing an inconsistency.

It seems to me this isn't right. This is the crux of our disagreement, I think.

What does it take for me to travel back in time to 1820 and step on a butterfly? On your view, as I understand it, two things have to be the case: (a) In 1820, I don't exist and don't step on the butterfly; (b) in 1820, I abruptly pop up in my time machine and step on the butterfly. Roughly speaking, for there to be time travel, there have to be two versions of what happens at a particular point in time: an original version and a modified version.

If that's what required for there to be time travel, then I think we should conclude that time travel is logically inconsistent. That conclusion is not, I think, dogmatic. Don't we agree that contradictions are logically inconsistent? We have all happily assumed this elsewhere in the course, e.g. in our proof by *reductio ad absurdum* that $|\mathbb{R}| > |\mathbb{N}|$. If you disagree, can you come up with some examples of true contradictions? (It's true that not quite everyone agrees that contradictions are logically inconsistent, e.g. dialetheists like Graham Priest. But that is very much a niche view. Just as it's not dogmatic to assume the earth is round, even though some people disagree, so too it's not dogmatic to assume that contradictions are inconsistent, even though some people disagree.)

But on the view I'm suggesting, that is not what's required for there to be time travel. All that's required is something along the lines of: (c) in 1820, I abruptly pop up in my time machine and step on the butterfly; (d) in 1821, tired of my adventures, I re-enter my time machine and abruptly disappear; (e) in 1991, I'm born in Glasgow; (f) in 2020, wishing to prove a point on the discussion forum of 24.118x, I enter my time machine and abruptly disappear; (g) some time later, I abruptly pop up in my time machine and continue moderating the forum. No contradictions, but still time travel.

I'm sure that this won't have convinced you. But maybe we're clearer on what exactly we disagree about: we disagree about what it takes for there to be time travel. And that's progress of a kind!

posted a day ago by **Cosmo_Grant** (Staff)

Hi Cosmo.

The funny thing is that my POV on time travel exactly matches your's!

So much that if you substitute your "On your view, as I understand it,..." with "On the lecture's view, as I understand it, ...", I would sign that sentence as if it was mine! That's what I undertand from the definition of logical inconsistency as explained for George McFly situatiom. If we apply that to George, shouldn't we apply it for any change at any given time?

Also I would sign your following sentence as if it was mine: "But on the view I'm suggesting, that is not what's required for there to be time travel..."

I guess I clearly failed at explaining my point, so please let me try another approach.

Coming back to this sentence of yours I've mentioned, you wrote:
" ...(c) in 1820, I abruptly pop up in my time machine and step on the butterfly ... ; then (d)... ; then (e) ... ; then (f)... ; then (g)... No contradictions, but still time travel"
I agree with this view 100%.

Now what I don't understand:
How can we say there's no contradiction in me poping up in 1820 and steping on a butterfly (which dies, or just becomes unhappy) (A), and at the same time affirm there's contradiction in me poping up in 1985 and finding George McFly rich and happy (B)?.

In other words: Is there a reason for considering B inconsistent but A consistent?.
If there is, I don't get it.
If there isn't, then I find dogmatic to say B is inconsistent but A is consistent, because the argument for considering B inconsistent due a change of George McFly state (from unhappy and poor to happy and rich), should be enough for considering A inconsistent due me poping up in 1820 and finding a change in the butterfly state (from happyly smelling a flower to being under my foot) .

Am I missing something?

posted about 9 hours ago by **Jimbof**

In story B, the butterfly never NOT gets stomped. (verbage gets weird when talking about time travel... its like we need another tense).

I think that is the answer in a nutshell, but to have a little more fun with it :

In this story, it might even be necessary for Cosmo to go back in time. Say that butterfly didn't get stomped. It went on to make lots of baby caterpillars, which turned into more butterflies and more caterpillars, which all infested Cosmo's grandfather's wheat field and he and his family starve. Ergo, no Cosmo.

So this is a completely different, consistent universe without time travel and without Cosmo.

The original universe, with time travel and Cosmo is also completly consistent. There is no case where the butterfly procreates.

posted about 6 hours ago by **ericcoker1974**

> How can we say there's no contradiction in me poping up in 1820 and steping on a butterfly (which dies, or just becomes unhappy) (A), and at the same time affirm there's contradiction in me poping up in 1985 and finding George McFly rich and happy (B)?

The story about the butterfly would be inconsistent if it said: "I step on the butterfly in 1820" and also said elsewhere "I don't step on the butterfly in 1820". But that's not the story. The story just says: "I step on the butterfly in 1820". It never says "I don't step on the butterfly in 1820".

The story you told about George McFly, as I understood it, said (among other things): "George McFly is happy at t" and also said elsewhere "George McFly is not happy at t". So it's inconsistent. If the story had *just* said, "George McFly is happy at t", or *just* said, "George McFly is not happy at t", then it would have been consistent, like my story about the butterfly.

You might ask: But if the story says "I step on the butterfly in 1820" and never says "I don't step on the butterfly in 1820", then how is there time travel in the story? Isn't it just a regular non-time travel story? I think the answer is no. That's what I tried to explain in my post above.

But I'm not sure if I'm understanding your view correctly. Maybe I've missed your point again?

posted about 6 hours ago by **Cosmo_Grant** (Staff)

Thanks again for commenting on this Cosmo.

If I understand this well then for a given moment and state in order to consider it as inconsistent, at some point we need to specify explicitly the state at that point, then later on, specify again said state but in contradicion with the first statement. If this is the case, aren't we transforming the issue into a matter of narrative?

Because the butterfly state before I pop up in 1820 is not indicated explicitly, but we can implicitly deduce it was flying freely, or smelling flowers, or doing whatever, but if we pop up out of the blue and find the poor butterfly under our feet, can't we assume "before our time travel I bet this butterfly was happier"? I firmly believe we can.

Consider the case a friend travels in time to a certain spacetime point, gets back and tells me: "Pal, don't pop up into "x", "y", "z" and "t" because there's an awesome butterfly hovering around!", then by mistake I end up at this very same coordinates so I step on the poor butterfly. In this case do we have an inconsistency? Just because the previous butterfly state was indicated explicitly? If this is the case I'm now more convinced on we need to adapt our consistency definition for time travel considerations.

posted about 4 hours ago by **Jimbof**

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