

A New Paradox of Time Travel

Connor R. Kelly and Eric A. Kincanon, *Gonzaga University*

Abstract

Time travel and its associated paradoxes are a topic of academic discussion that has historically been of interest only in physics and philosophy. This paper presents a new paradox of time travel that puts psychological issues at the forefront. The new time traveller faces conflicts between agency and agency awareness that are not addressed in other paradoxes. Further, in considering these other paradoxes it is seen how concerns about the time traveller's psychological state can lead to new challenges to the accepted deterministic paradox resolutions.

I. Background

For over a hundred years, time travel has been a point of serious discussion for physicists and philosophers.¹ For physicists, it is generally agreed that the equations of General Relativity and Quantum Mechanics allow for the possibility of time travel.² This often results in physicists attempting to resolve the paradoxes of time travel that are the focus of philosophers. Though it is argued that there are multiple paradoxes,³ there are good arguments for these all reducing to three: the Grandfather Paradox, the Self-cause Paradox⁴ and the Holt Paradox.⁵

The Grandfather Paradox looks at the problem of travelling into the past and killing one's grandfather when he was young. If you travel back in time and kill your grandfather when he was 10 years old, then he does not grow up to beget your father and of course you are not born. But if you are not born, then you do not get into the time machine to kill your grandfather; so, then he does beget your father. So, you are born and can get into the time machine and kill your grandfather, etc.

-
1. Gleick (2016).
 2. Everett and Roman (2013: 89–135).
 3. Nahin (2011: 167–240).
 4. Christoforou (2014).
 5. Holt (1981: 7–10).

The Self-cause Paradox is based in General Relativity and allows for an event to be its own cause. In other words: “x” causes “x”. The more general consequences of the Self-cause Paradox can be seen in the film “Timerider: The Adventures of Lyle Swann.”⁶ Swann travels from the present (1982) back 100 years and falls in love and starts a family. The twist occurs when Swann realises that his wife is also his grandmother. Swann, through two generations, begets himself. This paradox, as one might expect, can be quite complicated.⁷ The details, however, are not important for this discussion. Of importance here is that the Grandfather Paradox and the Self-cause Paradox share a common philosophical solution.

Both the Grandfather and Self-cause paradox consider a series of physical events that allow time travel. In both of these paradoxes the solution lies in accepting physical determinism.⁸ This is most easily seen with the Grandfather Paradox, but applies equally well to the Self-cause paradox. The solution is that you do not (will not) get into a time machine and kill your grandfather because that did not happen. Put directly, the past is fixed. This does not mean that time travel is not possible. It means that if time travel is actually carried out, it must occur in such a way that it is consistent with what we already know. It may be that you get into a time machine and travel to the past, but that is already part of the past. Again, the past is fixed. So, it may be that at some future time I travel into the past and, frustrated by the paradoxes, try to kill my grandfather as a boy. It must be that I am not successful because my grandfather was not killed as a boy. However, that doesn’t mean that I didn’t (don’t) try. The solution to this paradox could be seen in my grandfather telling stories of how he was chased around central Illinois in his youth by a middle-aged bald man who was trying to kill him and kept screaming stuff about paradoxes. That this solution to the paradox leads to a strong physical determinism can be seen most easily by considering travel into the future.

If you travel to tomorrow and see what you are having for lunch, then that is what you are going to have for lunch. You can’t return back and then decide to skip lunch, or pick something else. Central to this solution is that you travel to THE future, as you traveled to THE past. Responses to this, such as considering that we are travelling to a possible past or potential future, miss the point of time travel considered here. Going to a potential future, for example, really doesn’t tell us much. We

6. Dear (1982).

7. Horwich (1997: 259–267).

8. Smith (1997).

want to see which lottery numbers *WILL* be drawn; we already know what might be drawn.

A challenge to the above discussion is given by Read.⁹ Read argues that time travel is not possible for many reasons. Central to all of Read's objections is that he has a time traveller who possesses free will. As discussed above, the solution to the stated paradoxes is to realize that the traveller is going to the *THE* past or *THE* future. These must be fixed. All events, whether past, present or future, cannot have alternatives. This, of course, eliminates the possibility of any agent making real choices. So, Read's objections are founded if one requires that the time traveller has real options on which to act. In this case there is no solution to the Grandfather Paradox and, as Read properly argues, one is forced to reject time travel.

The Holt Paradox is concerned with the problem of there being a difference between personal time and worldline time for the time traveller.¹⁰ Holt argues that these differences lead to the impossibility of time travel because the duration experienced by the traveller cannot be made to align with worldline durations. As Holt points out in his paper's postscript, it may be possible to solve this by considering other versions of time travel. Further, Holt's argument could also be challenged in that it considers only time travel to the future by dismissing time travel to the past on the basis that there is no physics to support that theory.

It is important for the discussion of time travel to also specify the type of time traveller being considered and sticking to those parameters for the sake of this argument. In this paper we are assuming that the experience of the time traveller is much like that of a traveller in space. If we go to another city, we of course have experiences much like we do at home. We sense what is around us and we interact with and affect things just as we would at home. Watching a video of Seattle is not travelling to Seattle. Likewise, in this paper, we assume that our time traveller interacts with the travelled-to environment just as does any person in that time. This is necessary for this discussion because the particular way that this paper's time traveller makes observations is central to the paradox.

II. A New Paradox

As noted, the current paradoxes of time travel are concerned with physical interactions and have a solution that leads to deterministic

9. All of Read (2012) is relevant to time travel challenges, but section III d is of particular interest.

10. Holt (1981: 7–13).

conclusions. If the world is deterministic, then there are consequences that some find problematic. Perhaps the most obvious of these is the challenge to common notions of free will. If the future is determined, then there cannot be any real potential futures. So, how can we be making any choices? Though the consequences of accepting determinism are well discussed,¹¹ this paper argues that by considering psychological issues one can see how objectionable the deterministic solution might be.

Consider the case that you take your time machine and travel into the future (tomorrow) and observe your future self doing something, say eating lunch. Now you travel back to today and wait for the inevitable outcome that determinism requires. A psychological problem occurs in considering what your mind state is while you are eating lunch. Since you are a time traveller, you know that you'll be having a cheeseburger tomorrow. When tomorrow comes, what is it that you are thinking while you are eating? Can you think "Yup, here I am eating a cheeseburger, just like I saw it."? There is a paradox here, different from the three noted earlier, that leads to new challenges to the deterministic solution.

To see this, consider a different scenario. Imagine you time travel into the future, say two months, and observe your future self walking in a park texting on your cell phone. You see your future self suddenly stop and, in what is clearly a distressed state, feverishly text a message. Obviously, you got some very bad news. Here then is the paradox. What will be your psychological experience as the time traveller that knows that they will be getting bad news AND knows what their reaction will be? By adding to these events, it can be seen how psychological considerations lead to challenging the paradox solution.

Consider the same scenario as above. Now, however, you approach your future self and ask about the disturbing news. Your future self says that the text stated that a dear friend had been killed in an auto accident. Both of you are now very upset. Then a new text comes, informing you that it was a mistake. Your friend is fine and there is nothing to be worried about. Relieved, you travel back to the present. Here then is the key psychological problem. Why would your future self become upset over a text that you know is incorrect? As the time traveller, you have returned to the present and know that the upsetting text you will read in a few months is incorrect. It does not make sense that your future self becomes upset.

Being upset by a text you know is incorrect does seem odd. But, as understood by the deterministic solution to the earlier paradoxes, you did travel to THE future, so that is what WILL happen. The deterministic solution, thus far, is concerned with presenting a series of physical

11. Smith (1997).

events that is consistent with time travel. The example of time travel just given, however, presents a new dilemma. The concern now is not with having a consistent chain of events, but rather with understanding the psychological state of the time traveller.

III. Psychological Problems of Paradox

The time travel scenario just presented shows that psychological issues need to be addressed. This can be done by considering agency and agency awareness. Agency, here, simply refers to one's physical actions in the world as an experiencer and should not be mistaken for the common philosophical use of agency, which implies autonomy and free will. Agency awareness refers to one thinking about oneself and what one is doing. The problem the texting time traveller faces is that one cannot, in many cases, be an agent and at the same time have agency awareness. This can be clarified through some everyday examples. First, consider a case in which one can both have agency and agency awareness: Walking. Certainly, walking is an action in the world that the agent has control over. Though not true of a toddler, an adult can walk and think about other things, including the fact that they are walking. The physiological and psychological development necessary to do this are not of importance here. This simply serves as an example of how agency and agency awareness can be simultaneous. This is not true of all agency. Consider the case of a surgeon facing a new complex challenge. This task, as with many complicated and new tasks, requires the agent to remain focused. If the surgeon were to begin to think about the fact that she is a surgeon performing a complicated procedure (agency awareness), she would no longer be able to safely perform the task at hand. Another common example of this is when listening as part of a conversation (agency) – if... the listener starts thinking about where they are and the seriousness of the discourse (agency awareness), they are no longer aware of the details of the conversation.

A possible objection to the above argument is the case of multitasking. Someone might claim that they can carry out multiple, complicated tasks simultaneously. For example, a person could be carrying on a conversation while they type an unrelated email. Though it may seem to this person that they are doing these tasks simultaneously, research shows that this is not the case. Multiple investigations clearly show that people are quickly switching from task to task rather than actually multitasking simultaneously.¹² Here, multitasking is concerned with tasks that require

12. Much is written on this. A good place to start, is the well referenced papers: Dux *et al.* (2006), Hein *et al.* (2007) and Marios and Ivanhoff (2005).

some minimal concentration. It is possible, of course, to walk and carry on a conversation at the same time. But, as in the cases of interest for this paradox, these researchers considered tasks that are not associated with training or muscle memory.

The model of a driver and passenger in a car can be used to clarify the difference in states between agency and agency awareness. In this case, the driver is representing agency and the passenger is agency awareness. Imagine the case of the driver having to navigate an unfamiliar and complicated route. Focus is required. The passenger, since they are not driving, need not be focused and can observe the driver going through the complicated decisions. To the point, a person has the ability to be a driver and a passenger as a mind state separately. But, for many situations, like complex driving, a person cannot be both the passenger (awareness of agent) and driver (agent) at the same time.

Now consider what this means for the texting time traveller. When the bad news is texted, is the time traveller in a state of agency or agency awareness? The fact that the time traveller becomes upset would clearly point to a state of agency. If this were agency awareness, they would not be upset since they would be thinking about the upcoming text that informs them that their friend is fine. However, and this is central to this paradox, what would that psychological state be like, and is it even possible?

To clarify, imagine that you know, as a time traveller, you are going have a strong emotional experience. Experiencing those strong emotions would clearly be in a state of agency. However, as assumed, you know what you are going to feel. So, in this scenario, you do not think about that fact while you are experiencing the emotions. This is the paradox of the texting time traveller. This new paradox focuses on the problem of one not being able to choose between agency and agency awareness.

IV. Solution to the Texting Time Traveller Paradox

Determinism, again, could be the solution to this paradox. Given that you have observed your future self having an emotional response to the text, there are a few ways to quickly resolve this. First, we could imagine your future self just not trusting that all this time travel stuff is well understood. (Can you blame you?) Suppose on receiving the text you panic and aren't confident the text with the good news will come. You would, understandably, be upset. Though this is consistent with the observations, it seems reasonable that a scenario could be constructed which eliminates these doubts. A more confident time traveller, in a simpler scenario, for example.

The second possibility for resolving the paradox is of more concern and gets to the psychological issues of the deterministic solution. Since the texting time traveller is having a complex emotional experience, they must either be in a state of agency or agency awareness. If they are in a state of agency, it is of concern that they have somehow forgotten about the upcoming text with good news. Assuming the solution of the previous paragraph is not generally applicable, this leads to an absurd scenario. The texting time traveller could have observed long durations of his future life. This would then require him to be continually suspending his agency awareness. Further, if the texting time traveller is in agency awareness the situation is also absurd. This would require a situation as noted earlier, where the emotional state is occurring and the time traveller has agency awareness. It would require the person to be thinking about the fact that they are having emotional states and experience the states at the same time. It requires the texting time traveller to be the passenger and driver. In either case, the deterministic solution leads to a psychological state that is unacceptable.

An objection could be raised here that there seems to be a more fundamental problem with respect to agency and the determinist's solution just discussed. Why, it can be asked, can't the traveller choose a different future? Perhaps even one that does not include any of the scenario that leads to the meeting that is central to the paradox. This objection changes the type of time travel being considered here and noted in the first section. If the time traveller is going into the future, it is only considered here that they are travelling to THE future, not one of many possible futures. This is needed because if it is not THE future the traveller is going to, then what future is it? If it is to one of many possible futures, how and why can one future be selected over another? Further, what would be the point of travelling to a possible future? Suppose, deciding to be practical, the traveller decides to go to the future to see what winning lottery numbers will be drawn. It is useless to be going to one of many possible futures. Only what will happen can be of interest or use to the traveller. As an agent, one can of course consider many possible future scenarios. However, just because one can imagine these does not mean that they can be realized. In the determinist's solution, the traveller can still consider all the things that might happen. But, having time-travelled to the future, they now know what will happen.

V. Consequences of Solution

In general, to solve a paradox, either one challenges the truth of the assumptions or the validity of the argument. Determinism resolves the time travel paradoxes by challenging the truth of the assumptions. This

occurs in limiting what actions a time traveller can take; you cannot kill your grandfather. As argued above, the deterministic solution leads to potential psychological states that are contrary to our experience and, frankly, absurd. The determinist could respond to this by claiming a mistake is being made in attaching too much importance to these psychological states. Determinists could argue that beings, brains and minds are physical systems that are subject to the same determinism as falling rocks. Accepting this deterministic stance requires a particular type of agency. Agency could only be the physical interactions that are occurring due to the natural laws that govern the behaviour of our parts. It cannot be that our agency in the world includes us making real choices or possessing common notions of free will. Likewise, our awareness of agency is only a consequence of that physical arrangement of our parts. We do not choose in any sense. Not only do we not choose how we act under determinism, we do not choose between agency and agency awareness.

Counter to this, the paradox could be solved by rejecting time travel. If the world is such that time travel is not possible, then it could be that agency (choice) is real. The supporter of this solution would argue that the consequences of time travel being possible (determinism) are unacceptable. Therefore, either the assumptions or the validity of the argument must be questioned. Since the argument is valid, one can only challenge the argument by rejecting the assumption that time travel is possible. This is not as simple as it appears. Deciding to reject time travel because of the consequences of determinism flies in the face of a robust history in physics and philosophy. Challenges to determinism are complex and have been, philosophically, far from certain.¹³

Looking at this from a psychologist's standpoint is to ask how fundamental and necessary are agency and agency awareness. This paper has presented how many physicists would make a reductionist argument that brains are just physical objects that are subject to the same deterministic natural laws as any other object. Psychologists may have a strong challenge to this approach by arguing for the necessity of a non-reducible agency and agency awareness.

VI. Summary

James Gleick is right, "Time travel is sexy."¹⁴ The use of time travel in film and literature can be very entertaining. In physics and philosophy,

13. Campbell *et al.* (2004) is a collection of contemporary essays that examine the breadth of the challenges in determinism.

14. Gleick (2016: 226).

the paradoxes of time travel have led to serious academic work and discussions of the necessity of determinism. Considerations from psychology, and the new paradox introduced in this paper, demonstrate how the deterministic solution may be unacceptable. It may be that the “psychological” time traveller has something important to add to the discussion thus far dominated by physicists and philosophers.

Physics Department
Gonzaga University
502 E Boone Ave.
Spokane, WA 99258
kincanon@gonzaga.edu

References

- Campbell, J., M. O'Rourke, and D., Shier (2004). *Freedom and Determinism*. Cambridge, MA: MIT Press.
- Christoforou, P. (2014). 5 Bizarre Paradoxes of Time Travel Explained. Astronomy Trek Website. <http://www.astronomytrek.com/5-bizarre-paradoxes-of-time-travel-explained/>
- Dear, W. (1982). *Timerider: The Adventure of Lyle Swann*. United States: Zoomo Productions.
- Dux, P., J. Ivanhoff, C. Asplund and R. Marios (2006) “Isolation of a Central Bottleneck of Information Processing with Time-resolved fMRI.” *Neuron* 52: 1109–1120.
- Everett, A. and T. Roman (2013). *Time Travel and Warp Drives: A Scientific Guide to Shortcuts through Time and Space*. Chicago: University of Chicago Press.
- Gleick, J. (2016). *Time Travel: A History*. New York: Pantheon.
- Hein, G., A. Alin, A. Kleinshmidt, N. Muller and S. He (2007) “Competing Neural Responses for Auditory and Visual Decisions.” *PLoS One* 2: e320.
- Holt, D. C. (1981) “Time Travel: The Time Discrepancy Paradox.” *Philosophical Investigations* 4: 1–16.
- Horwich, P. (1997). “Closed causal chains.” In S. Savitt (ed.) *Time's Arrows Today: Recent Physical and Philosophical Work on the Direction of Time*. Cambridge: Cambridge University Press.
- Marios, R. and J. Ivanhoff (2005) “Capacity Limits on Information Processing in the Brain.” *Trends in Cognitive Sciences* 9: 296–305.
- Nahin, P. (2011). *Time Travel: A Writer's Guide to the Real Science of Plausible Time Travel*. Baltimore: John Hopkins University Press.

Read, R. (2012) "Why There Cannot be Any Such Thing as 'Time Travel'." *Philosophical Investigations* 35: 138–153.

Smith, N. (1997) "Bananas Enough for Time Travel?" *British Journal of the Philosophy of Science* 48: 363–389.