

Temporal Travel and the Timeline Quiver

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Abstract

If travel into the past is possible, an intervention may remove a condition necessary for the journey by which it occurred. I propose that such an intervention would occasion a restoration of the affected history, ordinarily followed by an identical recurrence. An exceedingly rare random departure from this repetition, termed a *timeline quiver*, might permit a consistent course in which the incompatible intervention cannot be completed or the journey itself cannot occur. The departure need not originate near the traveller, and a minute difference may suffice, although neither its magnitude nor the severity of its consequences is restricted by the proposal. The distinction between recurrence and quiver is developed through hypothetical cases. The account leaves the physical means of restoration unresolved and does not establish that every recurrence must terminate.

1. The difficulty introduced by a return

A traveller who arrives in the past brings with him a difficulty which an ordinary visitor does not. The conditions responsible for his arrival may still be open to his interference. He might prevent a meeting upon which his birth depends, or interfere more directly with the circumstances of his eventual departure. If he succeeds, the history must account for an intervention while lacking a condition required for its occurrence. The familiar example involving an ancestor makes the difficulty vivid, but ancestry has no special place in the argument. Preventing the journey would be sufficient.

There are mathematical reasons for considering the question without claiming that such a journey can be made. Gödel's cosmological solution admits closed timelike curves, and Carter's discussion of the extended Kerr family provides a further setting in which these curves arise.[1,2] A mathematical description of such a path leaves open whether a material traveller could follow it. I shall assume, for the purpose of the present argument, that travel into the past is possible under some conditions. No means of accomplishing it is proposed here.

Even on that assumption, an encounter with the past need not produce an inconsistency. A traveller might converse with someone, move an object, or leave a letter, while the circumstances leading to his departure remain intact. His participation could belong to the history all along. The decisive question concerns what would happen if his intervention removed a necessary condition of that very participation.

It is tempting to describe the problem as a conflict between a traveller's freedom and an obstinate past. This description places too much weight on intention. An accidental act could have the same consequence as a deliberate one, while the most determined attempt might fail to affect any necessary condition. The relevant relation is between events. Whether the traveller understands that relation should make no difference to the difficulty it presents.

I propose that an incompatible intervention would occasion a restoration of the affected course of events. Ordinarily, those events would recur without alteration. Exceptionally, a departure

from the repeated course might allow a history to continue without the inconsistency. These two suppositions, restoration and exceptional departure, require separate consideration.

2. Restoration and recurrence

By restoration I mean a return of the affected history to a condition preceding the incompatible alteration. The term specifies a proposed occurrence; it supplies no physical account of how that occurrence would be brought about. Nor does it determine how far the restoration must extend. A local description of the traveller's act may involve causes and consequences beyond the immediate scene, so the boundary of the affected history cannot simply be drawn around the traveller.

If the restored circumstances reproduce everything which determined the attempt, they should reproduce the attempt as well. The same opportunity would present itself, the same considerations would occur to the traveller, and the same action would follow. There is no reason to expect him to improve his conduct merely because the events have occurred before in the proposed succession. Any recollection of a preceding attempt would itself be a difference requiring explanation. I shall not assume that recollection survives.

A rehearsal offers an inviting comparison. One repeats a difficult action until it succeeds, benefiting from each preceding failure. Yet that comparison gives the traveller a resource which restoration may remove. The actor at a rehearsal remembers; the restored traveller may begin with precisely the same experience and dispositions as before. I am inclined to use the language of successive attempts, but it must not quietly introduce successive lessons. Without a difference in the relevant conditions, repetition provides no instruction.

Restoration would therefore reproduce the difficulty it was invoked to remove. Another incompatible intervention would occasion another restoration, and a succession beyond any practical means of enumeration could follow without alteration. The mere size of this succession supplies no cause of change. An event does not become different because it has become tiresome to describe.

There is also a difficulty in speaking of one recurrence as coming after another. A clock included in the restoration would repeat its readings. The traveller could not add the duration of each recurrence and regard the sum as time elapsed within the history that finally remains. The order of recurrences belongs to the proposed restoration process, and that order is an additional demand upon the account. Naming it does not explain it. No second measurable time is established by this manner of speaking.

The precise instant at which restoration would occur is likewise unsettled. A traveller's intention alone does not constitute an incompatible history, and a failed intervention may fit the history without difficulty. The conjecture attaches restoration to the incompatibility of the resulting course, while leaving the physical trigger unspecified. This incompleteness matters: a description of what must be avoided cannot, by itself, tell us how events would avoid it.

3. The exceptional departure

By a *timeline* I mean here a complete course of events, as distinct from the world line of an individual body. I shall call an exceptional random departure from the otherwise repeated course a *timeline quiver*. Such departures are assumed to be exceedingly rare. An inconceivably long succession might reproduce the same events before even a slight difference appeared. No particular number of recurrences, and no numerical frequency, is assigned to the effect.

The word *random* requires some restraint. It does not mean that every restoration rearranges a few details, nor does it mean that each recurrence offers an independent trial with a fixed chance of success. The present suggestion supplies neither a probability law nor a rule connecting one departure with another. It supposes only that, on an exceptional recurrence, events may differ without being directed towards a particular remedy. Most of the supposed succession could remain wholly unchanged.

Here the proposal meets its most direct objection. Complete restoration, followed by precisely the same determining conditions, would reproduce the same course. A quiver cannot be deduced from that statement, however often it is repeated. To admit quiver is to suppose that the restoration or subsequent development fails, exceptionally, to reproduce everything relevant to the preceding outcome. Some influence not itself subject to restoration might account for the difference, although its nature is left undetermined. The exception is an added hypothesis; without it, restoration alone would leave the recurrence unresolved.

One might try to ease this difficulty by appealing to the enormous number of repetitions. Given enough occasions, it seems that something must happen differently. But this is precisely where the argument is liable to borrow what it needs to prove. A large number of recurrences can provide many occasions for a departure only if departure is already possible under the governing conditions. Counting identical recurrences cannot supply that possibility. I retain the assumption of rare departures, but can offer no numerical argument for their occurrence.

The first departure need not concern the traveller. A slight displacement elsewhere, or a small difference in the interval between two events, could affect circumstances upon which his intervention later depends. Its importance would then arise through subsequent events. A difference which appears trivial where it begins might become decisive at the point of intervention; conversely, an obvious disturbance might leave the disputed causal relation untouched.

Nor need the first quiver resolve the difficulty. It could change several events while leaving the incompatible act possible. Such a course would remain subject to restoration. The proposal does not specify whether later recurrences reproduce this altered course or restore an earlier one, and no argument here depends upon a choice between them. In particular, successive departures must not be treated as corrections that accumulate until they reach the right answer. A process which retains each useful change and rejects each useless one would require a further rule.

4. Small differences and their consequences

Consider a traveller who intends to prevent a meeting necessary to his own birth. Suppose that his intervention depends upon reaching a particular place before that meeting occurs. A small alteration in the circumstances of his arrival might leave him too late. The meeting would take place, the conditions of his birth would remain, and his unsuccessful intervention could belong to a consistent history. In this example, a slight difference suffices because the opportunity is narrow. Nothing requires the traveller to abandon his intention or to understand why he failed.

The example can be carried farther. The delay might begin with someone who has no knowledge of the traveller: a person who occupies a passage for a little longer than before, or whose ordinary business changes the traveller's route. It is easy to continue adding such circumstances until the entire world appears occupied with obstructing one man. That impression arises from selecting an example after specifying the result. The stranger need have no purpose beyond his own business, and a random departure need have no tendency to inconvenience the traveller. Only some departures would affect the opportunity at issue.

There is a further condition which the simple example conceals. The traveller may find another opportunity. A late arrival prevents one intervention, but may leave him able to make another which produces the same incompatibility. A delay is therefore a sufficient ending only if the resulting history contains no later completion of the contradictory act, and no other incompatibility introduced by the change. One failed attempt cannot certify the remainder of a life.

This qualification also changes what it means for the traveller to become incapable of altering the past. He might remain able to speak, move objects and influence people. The terminating history must exclude the incompatible intervention, not all action in an earlier period. An incapacity could be as limited as the permanent loss of a necessary opportunity. Nothing in the conjecture requires a universal paralysis whenever a traveller tries to act.

Small causes have an understandable attraction in these examples. They allow the difficulty to be removed without disturbing much else, and they make the proposed account easier to picture. But the convenience of the example does not establish a principle of least disturbance. The claim that a minute difference may suffice places no upper bound on quiver itself. Equally, a small initial difference need not have small eventual consequences.

The conjecture consequently provides no assurance of a tolerable outcome. A catastrophe, including the unexplained death of everyone concerned, cannot be excluded merely because a lesser interruption would also have prevented the act. Even a catastrophe extending to all human life is not ruled out by the consistency requirement alone. Such an ending would still have to leave a history whose events can occur together; killing the traveller after an incompatible act would not automatically repair it. I see no justification for assigning these possibilities a frequency, or for assuming that the process favours the least destructive among its possible endings.

5. A history without the journey

The traveller's failure is only one possible form of termination. A quiver might instead prevent the circumstances of the temporal journey from arising. The history which remains would then contain no such journey and no intervention dependent upon it. This possibility deserves separate attention because it appears, at first, to reproduce the original difficulty: a process occasioned by a journey has ended by removing that journey.

The distinction depends upon the separation already made between the order of recurrences and the chronology within any one course. In the proposed account, an abandoned recurrence would not remain as an event inside the final history. A journey in such a recurrence could belong to the restoration process even though no corresponding journey appears in the history that continues. The final course would not have to contain both the departure and its absence.

This is a substantial supposition. It permits a history to be replaced as a whole, or to an extent sufficient to remove the incompatible relations, while treating the abandoned course as part of a separate succession. Ordinary chronology alone does not provide that succession. A reader who accepts only events within the final history will find that the earlier recurrences have been given no place to occur. The present proposal asks that their occurrence be admitted; it does not obtain that admission from the consistency of the final course.

Suppose, for example, that an altered circumstance prevents the traveller's departure. It would be insufficient simply to cancel that departure while retaining an arrival caused by it. The history would still contain the disputed dependence. A terminating course without the journey must also account consistently for the absence of its arrival and its effects. In stating this requirement I am specifying the condition an acceptable ending must meet, not describing a known means by which restoration would meet it.

The same caution applies to examples in which the traveller dies. Death before departure may remove the journey from a consistent replacement history. Death after arrival could leave a consistent visit followed by death, provided the corresponding departure still occurs and the visit has not removed its necessary causes. Neither example offers a general solution by itself. Their different consequences show why the traveller's survival is an unreliable measure of whether the difficulty has ended.

It would be possible to multiply these cases almost without limit, especially by introducing further travellers. The present argument does not establish that every combination of journeys has a consistent replacement. Its narrower claim is that a course without the original journey can count as an ending under the proposed distinction between recurrences and the history that remains. Whether a physical account could sustain that distinction is still open.

6. Stability and the possibility of continued recurrence

I use *stability* to mean that a course can continue without another restoration occasioned by the incompatibility under discussion. A stable history in this sense could contain violent changes and widespread misfortune. Stability describes the compatibility of its events, and implies neither quietness nor the fulfilment of anyone's purposes.

To say that a timeline seeks stability may suggest that it anticipates a contradiction and arranges a remedy. No such foresight has been supplied. Under the conjecture, incompatible courses

occasion restoration, while a consistent course requires no further restoration on that account. An appearance of successful adjustment could arise from the persistence of the course which remains. Nothing in that description gives an individual quiver knowledge of the result it would need to produce.

It is therefore premature to say that repetition must end. The existence of a consistent course would not show that the supposed departures can reach it. Even if they can, an immense succession of recurrences would not establish that they will. The permitted departures might fail to affect the relevant circumstances, or might repeatedly leave an incompatibility elsewhere. No account of their occurrence has been given from which inevitable termination could be inferred.

My inclination is to suppose that recurrence continues until a consistent history remains. That is the intended operation of the conjecture, but the word *until* carries an assurance which the preceding argument has not earned. The defensible statement is conditional: if the process reaches a course requiring no further restoration, the recurrence has ended. An indefinitely repeated course remains a difficulty for the proposal. It cannot be dismissed by writing down a sufficiently large number of repetitions.

7. Status of the conjecture

The proposal distinguishes the return of a history from the exceptional difference which might permit it to continue. Restoration ordinarily reproduces the circumstances responsible for the difficulty. Quiver introduces the rare departure through which those circumstances might cease to produce an incompatible intervention. A consistent outcome could preserve the traveller's journey or remove it from the history which remains.

Neither restoration nor quiver has been derived here from the gravitational field equations. The relativistic examples cited at the outset allow a question about return to the past to be formulated; they supply no evidence for the particular answer offered here. The further burden of the proposal is to give physical meaning to the succession of recurrences and to explain why an otherwise repeated course could depart from its predecessor.

There is an evident temptation to treat an unlikely failure as a trace of the process. A traveller arrives too late, and one imagines innumerable discarded arrivals behind his misfortune. The account does not warrant that inference. The same failure, considered by itself, would give no means of distinguishing the conjectured process from a history in which no restoration occurred. If every relevant record were restored, even the number of recurrences might be inaccessible to anyone within the continuing history.

The conjecture would acquire a physical basis only through an account of restoration and departure with consequences that could be examined independently of the story used to illustrate them. Until then, an occurrence which happens to preserve consistency cannot establish that a quiver has taken place.

References

- [1] K. Gödel, "An Example of a New Type of Cosmological Solutions of Einstein's Field Equations of Gravitation," *Reviews of Modern Physics* **21**, 447–450 (1949).
- [2] B. Carter, "Global Structure of the Kerr Family of Gravitational Fields," *Physical Review* **174**, 1559–1571 (1968).