# Grandfather paradox in time travel

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## Grandfather paradox in time travel

The most well-known example of the impossibility of traveling in time is the grandfather paradox or self-infanticide argument: (Horwich 1987) a person who travels in the past and kills his own grandfather, thus preventing the existence of one of his parents and thus his own existence. A philosophical response to this paradox would be the impossibility of changing the past, (Swartz 2001) like Novikov self-consistency principle (if an event exists that would cause a paradox or any "change" to the past whatsoever, then the probability of that event is zero, thus it would be impossible to create time paradoxes). The paradox involves any action that changes the past. (Smith 2016)

Grandfather paradox is presented in many ways: physicist John Garrison presents a variation with an electronic circuit that sends a signal through a time machine that decays alone

and receives the signal before sending it, (Garrison et al. 1998) and the self-infanticide paradox involves returning to time and killing one's own person while he was a child. (Horwich 1987)

From a logical point of view, the paradox is a logical contradiction: if an event has taken place in some way, there is no possibility that the event has occurred otherwise. (Swartz 2001) Bradley Dowden argues that the possibility of creating a contradiction excludes travel in the past.

An approach to this paradox is a parallel universe: when the time traveler kills his grandfather, he kills in fact a parallel version of his grandfather, and the original universe of the time traveler is unchanged; in other variants, the time traveler tries but fails to kill his grandfather.

According to Novikov self-consistency principle, physics in or near closed timelike curves (time machines) can only be in accordance with the universal laws of physics, and so only coherent events can occur. Novikov used the example given by Joseph Polchinski for his grandfather paradox to show how this system can be solved in a coherent way that avoids the grandfather paradox, although it creates a causal loop. (Lossev and Novikov 1992) Hawking states as follows:

> "By traveling in a space ship on one of these closed timelike curves, one could travel into one's past. This 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*." (Hawking 1992)

Lewis' own solution to this problem has been widely accepted: the traveler may enter the past without killing his grandfather, but we still have a contradiction: for he can do it and cannot do it:

> ” Could a time traveler change the past? It seems not: the events of a past moment could no more change than numbers could. Yet it seems that he would be as able as anyone to do things that would change the past if he did them. If a time traveler visiting the past both could and couldn’t do something that would change it, then there cannot possibly be such a time traveler.” (Lewis 1976)

Grandfather's shooting is compossible with the facts about his weapon, his formation, his mood, and so on, but it is not compossible with other facts, such as the fact that his grandfather did not die this way. Thus, "murder" is true in a sense (relative to a set of facts) and false in a different sense (to another set of facts), but there is no sense in which it is both true and false. So, there is no contradiction here - just an ambiguity. (Smith 2016)

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