The time travel of *Dark*

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PART 1.
1.1 SEASON ONE: LUDOVICIAN TIME TRAVEL
1.1.1 First things first
1.1.2 Can a person time travel to or from a time that does not exist yet?
1.1.3 Can time travel change the past?
1.1.3.1 Ludovician time travel
1.1.3.2 Non-Ludovician time travel
1.1.4 Conclusion
1.2 SEASON TWO: MORE LUDOVICIAN TIME TRAVEL AND CAUSAL LOOPS
1.2.1 What is a causal loop?
1.2.2 Do events in a causal loop repeat over and over?
1.2.3 Causal loop peculiarities
1.2.4 Is there a way out of a causal loop?
1.3 SEASON THREE: SCHRÖDINGER'S CAT AND NON-LUDOVICIAN TIME TRAVEL
1.3.1 The three rules of non-Ludovician time travel using the loophole
1.3.2 How many superpositions are created?
1.3.2.1 In Adam's world
1.3.2.2 In Eva's world
1.3.3 Why am I assuming that characters travel between worlds using time travel?
1.4 FINALE: HYPERTIME TRAVEL
1.4.1 The hypertime solution
TL;DR
PART 2.
2.1 FREE WILL
2.1.1 If everything is "set in stone", what about free will?
2.1.2 How would the characters act differently if they did have this magical free will?
2.2 WHAT'S IN A NAME?
2.2.1 Self-consistent time travel
2.2.2 Deterministic time travel
2.3 THE GRANDFATHER PARADOX
2.3.1 "If I can travel to the past, I can surely kill my grandfather before he meets my grandmother."
2.3.2 Why do alt-Martha and Jonas disappear?
2.4 A MÖBIUS LOOP
2.5 THE ANGEL OF DEATH
2.5.1 The vacuous explanation
2.5.2 Could Claudia "continuously pass information to her younger self"?
2.5.3 Unrealisable desires
2.6 ETERNAL RECURRENCE
2.6.1 Resetting worlds
2.6.2 This is not going to end the way you think
TL;DR
References

PART 1.

1.1 SEASON ONE: LUDOVICIAN TIME TRAVEL

“Imagine travelling back in time and meeting your father before he had you. Would you have already changed things with this encounter? And is it even possible to change things? Or is time an eternal beast that can’t be defeated?” -H. G. Tannhaus

When I started watching *Dark*, I did not know what to expect. I thought it was a run-of-the-mill crime investigation series and I honestly was not too interested. However, I liked what I saw in the first episode… And then, Mikkel Nielsen disappears from 2019 and appears in 1986.

At that moment I was really hooked. I love stories that include (coherent) time travel.

This essay attempts to explain exactly how time travel works in this particular story and is divided into two parts.
Part 1 explains the main logical paradox-free types of time travel that theoretically exist and provides examples of which types we find in *Dark*. Please note that the first chapter contains no spoilers for seasons two and three, and the second chapter contains no spoilers for season three.
Part 2 deals with specific topics that arise throughout the series and is full of spoilers. There is also a "too long; didn't read" section at the end of each part.

1.1.1 First things first

The first thing we must take into account when considering time travel is the important difference that exists between the *personal time* of a character (or an object) and the *external time* of the world. Philosopher David Lewis points this out in his iconic paper, *The Paradoxes of Time Travel*, published in 1976. In fact, Lewis’ definition of time travel is “a discrepancy between time and time“, referring precisely to the discrepancy between the time traveller’s personal time and the external time of the world.

When Mikkel enters the passage in the caves at the age of 11, his personal time continues to run forward at the usual rate of a second per second, but in an instant of that personal time, he travels back 33 years in the external time of the world, from 2019 to 1986. From that moment on, he will continue growing, celebrating birthdays in his personal time (as we all do), in the years of external time previous to his birth (becoming 12 years old in 1987, 13 in 1988, 14 in 1989, and so forth), until he dies at the age of 44, in 2019.

This fact raises two immediate questions, one from each end of the journey. A person in 1986 could ask, “Can a person time travel to or from a time that does not exist yet?” and a person in 2019 could ask, “Can time travel change the past?”

1.1.2 Can a person time travel to or from a time that does not exist yet?

As philosopher William Grey writes in *Troubles with time travel*, 1999, “A fundamental requirement for the possibility of time travel is the existence of the destination of the journey. That is, a journey into the past or the future would have to presuppose that the past or future were somehow real” (Grey 1999, 56).

Even some who would deny the possibility of time travel agree with this. William Godfrey-Smith, in *Travelling in time,* published in 1980, states that “The metaphysical picture which underlies time travel talk is that of the block universe [...], in which the world is conceived as extended in time as it is in space” (Godfrey-Smith 1980, 72).

This picture of the existence and nature of time is called *eternalism* and, as the Stanford Encyclopedia of Philosophy states, “According to eternalism, non-present objects like Socrates and future Martian outposts exist now, even though they are not currently present. We may not be able to see them at the moment, on this view, and they may not be in the same space-time vicinity that we find ourselves in right now, but they should nevertheless be on the list of all existing things.” (Emery, Markosian, and Sullivan 2002) In other words, we know the North Pole exists, even though we are not there because it is in another location in space; according to eternalism, past and future events are similar—they exist, but in another location in time.

Even though it is not necessary for some types of time travel, for *all types* of time travel to work, it is best to first accept the universe as a so-called 4D “block universe” that exists as a whole. This may sound very strange, and undoubtedly it is to our daily experience, but so are the physical forces that govern our universe. Remember, the first quote we encounter when entering *Dark* is “The distinction between past, present and future is only a stubbornly persistent illusion.”

If this static view of time—in which the passage of time is not real—is too bizarre to grapple with, one might prefer the “Moving Spotlight Theory”. According to this view, the universe still is a block universe in which past and future are equally real, but the passage of time is also real and so there is a present moment that moves along the block. Entities and events in the block possess special temporal properties; as time passes, first they “are future”, then they “are present” and then they “are past”. The problem is for the Moving Spotlight theorist to decide where the present is when people (or objects) start travelling through time.

1.1.3 Can time travel change the past?

When writing time travel stories such as *Dark*, even if these are sci-fi and portray physically impossible events—such as the mere fact of time travelling—, they can nevertheless be metaphysically or logically possible if they maintain the logical consistency of reality by strict adherence to laws of logic, such as the law of non-contradiction, which states that *contradictory propositions **cannot** both be true in the same sense at the same time*. For example, an object cannot be *and not be* an apple in the same sense at the same time.

With this in mind, let us consider the following proposition: *<At 1986: Mikkel does not exist>.*

If this is true (and it would seem to be, because his birth is in 2008), he cannot possibly time travel to that year from the future. If he did, it would result in two contradictory propositions (<Mikkel does not exist> and <Mikkel does exist>) being both true in the same sense at the same time (in 1986). This would break the mentioned law of non-contradiction and entail an unsolvable contradiction, a paradox we can call the Paradox of the Changing Past (Effingham 2020). If an event happens, that same event cannot *not* happen at the same time, and if an event does not happen, it cannot happen.

Would this not mean that time travel is not even logically possible—not even possible in principle? Indeed, but we need time travel to be at least *logically* possible for any time travel story to be coherent (although stories with illogical time travel can still be very entertaining and great fun, of course (*Back to the Future* is an all-time favourite)). Given this, we have two options to avoid the paradox and obtain a logically possible time travel. I will use Mikkel's journey as an example, to hopefully verify that what we see fits with one of them.

1.1.3.1 Ludovician time travel

The first type of time travel I present avoids the contradiction by affirming that, if Mikkel time travels from 2019 to 1986, the stated proposition *<At 1986: Mikkel does not exist>* is false and consequently the opposite is true, Mikkel does exist in 1986 (see Figure 1). What is more, that Mikkel exists in 1986 will be true regardless of how many times anyone time travels. *Nothing* can stop him from travelling to 1986, and even if someone tries to avoid this, the fact that he exists in 1986 means that they will inevitably fail due to plausible reasons. The past and the future are equally real, just as they are in a story, where no event that happens can be avoided. There is no sense in which we can say that the past or the future changes.

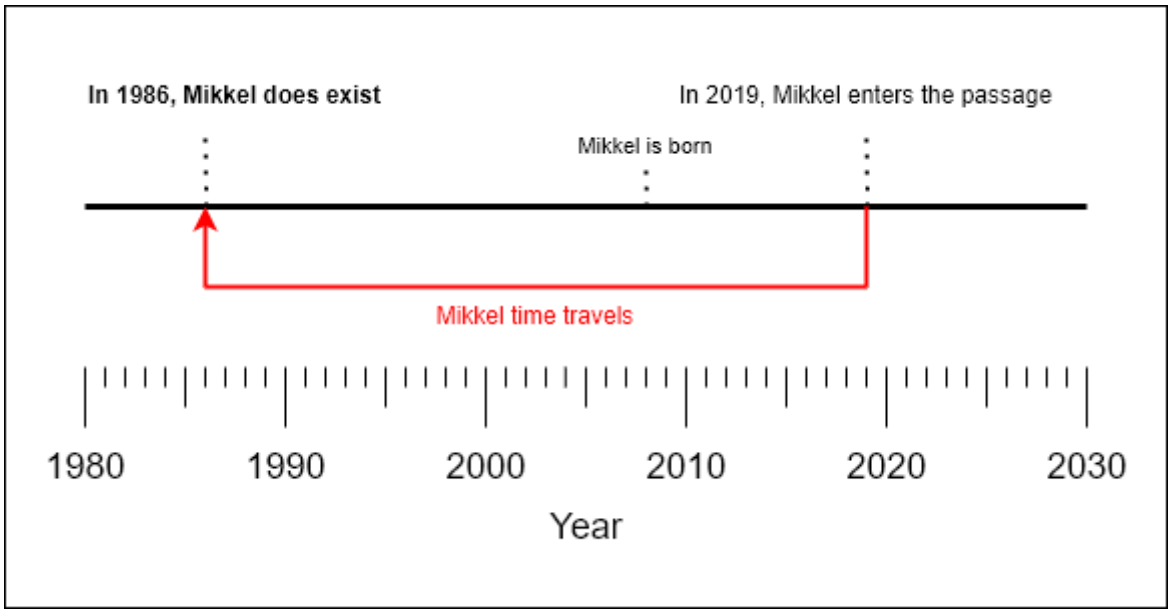


Figure 1: Ludovician time travel.

This time travel is called *Ludovician time travel* in honour of the mentioned philosopher David Lewis (Ludovicus is the Latin form of Lewis, and hence Ludovician), who proposed it as a solution to the Paradox of the Changing Past. Other names for this time travel are “self-consistent time travel”, or “deterministic time travel”, and even though the “self-consistent” label is technically correct, I stick with Ludovician (and reject the “deterministic” label), but I will explain why in part 2.

1.1.3.2 Non-Ludovician time travel

The second type of time travel obtains the unexpected: that two otherwise contradictory statements—such as <At 1986: Mikkel does not exist> and <At 1986: Mikkel does exist>—are *both* true. How can that be possible, if both propositions **cannot** be true in the same sense AND at the same time?

The Devil is in the details. To be logically possible, they have to be true in a different sense OR at a different time, so a non-Ludovician time travel will add an additional index to the contradictory propositions (Nikk Effingham labels this as “time travel in indexed worlds” in his excellent 2020 book, *Time travel - Probability and Impossibility*).

- **How both propositions can be true but not in the same sense.**

This would be the case if we consider that possible time travellers, upon arrival, create a diverging *branch of reality* in the timeline of their universe (a diverging timeline). Adding the appropiate indices, the propositions are now:

<In timeline 1: at 1986: Mikkel does not exist>.
<In timeline 2: at 1986: Mikkel does exist>.

Both propositions can be true with no contradiction. They are both true at the same time (at the same moment in 1986) but not true in the same sense, they are true in different timelines (see Figure 2).

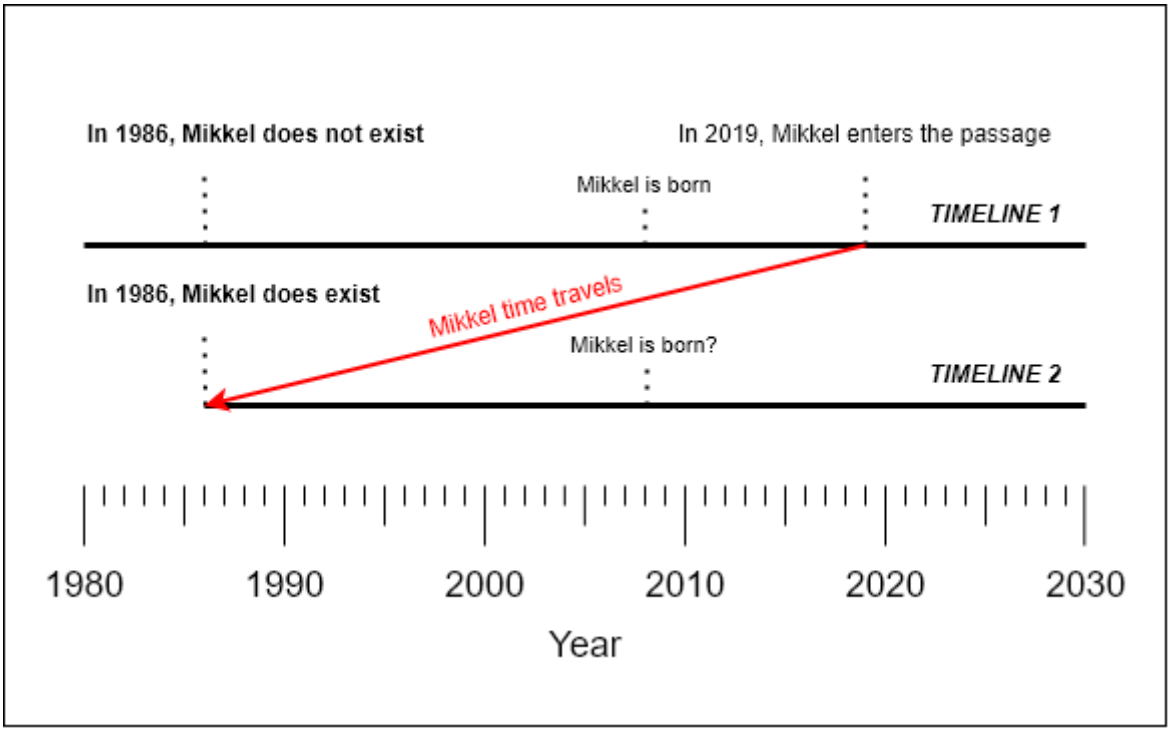


Figure 2: Non-Ludovician timeline travel.

There are many ways in which we can conceptualise this time travel, which I will call *timeline travel* to differentiate it from the following time travel below. Figure 2 represents a whole timeline that branches into a new one, so both timelines share a common past with different futures, but we could also imagine that the future of timeline 1 disappears from the point at which the time traveller leaves, or we could imagine that timeline 2 is a whole independent timeline whose past is just like the one in timeline 1 (although we could argue that this is no longer time travel, but a journey to another universe or world). Whatever the case, according to this option of time travel, Mikkel would not exist in 1986 *in one timeline* and would create *a different timeline* in which he would exist in 1986. This new timeline, be it slightly or substantially, will be *necessarily different* (another Mikkel might not even be born).

- **How both propositions can be true but not at the same time.**

This would be the case if we consider that possible time travellers make a past moment happen *a second time* as a consequence of their journey. The only way to make sense of this is to assume an extra dimension of time in which events in the past can actually happen a "second time". This extra dimension of time is usually called *hypertime*, so we might say that these travellers do not time travel, but that they in fact *hyper*time travel, and that although two events apparently happen at the same time, they in fact happen at different hypertimes.

<At hypertime *T1*: at *t1* (1986): Mikkel does not exist>.
<At hypertime *T6*: at *t1'* (1986): Mikkel does exist>.

Both propositions can be true with no contradiction. They are both true in the same sense, and although the time at which events happen may be the same, the hypertimes are different (see Figure 3).

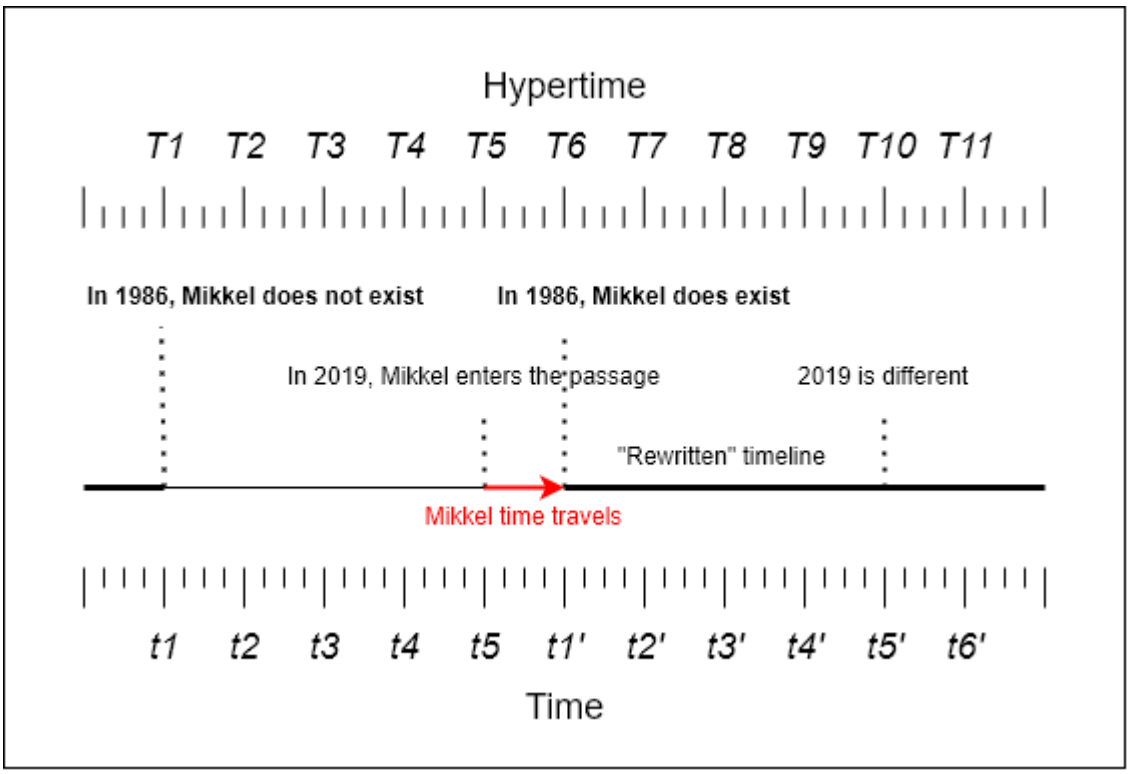


Figure 3: One-dimensional representation of non-Ludovician hypertime travel. After leaving *t5 (2019)*, the traveller returns to *t1 (1986)* and rewrites the timeline, so now it starts at *t1' (1986)* and the thicker sections of the timeline are the only parts accessible to time travellers.

As this is a two-dimensional type of time travel, we can also map the timeline on two axes that may make it easier to understand (see Figure 4).

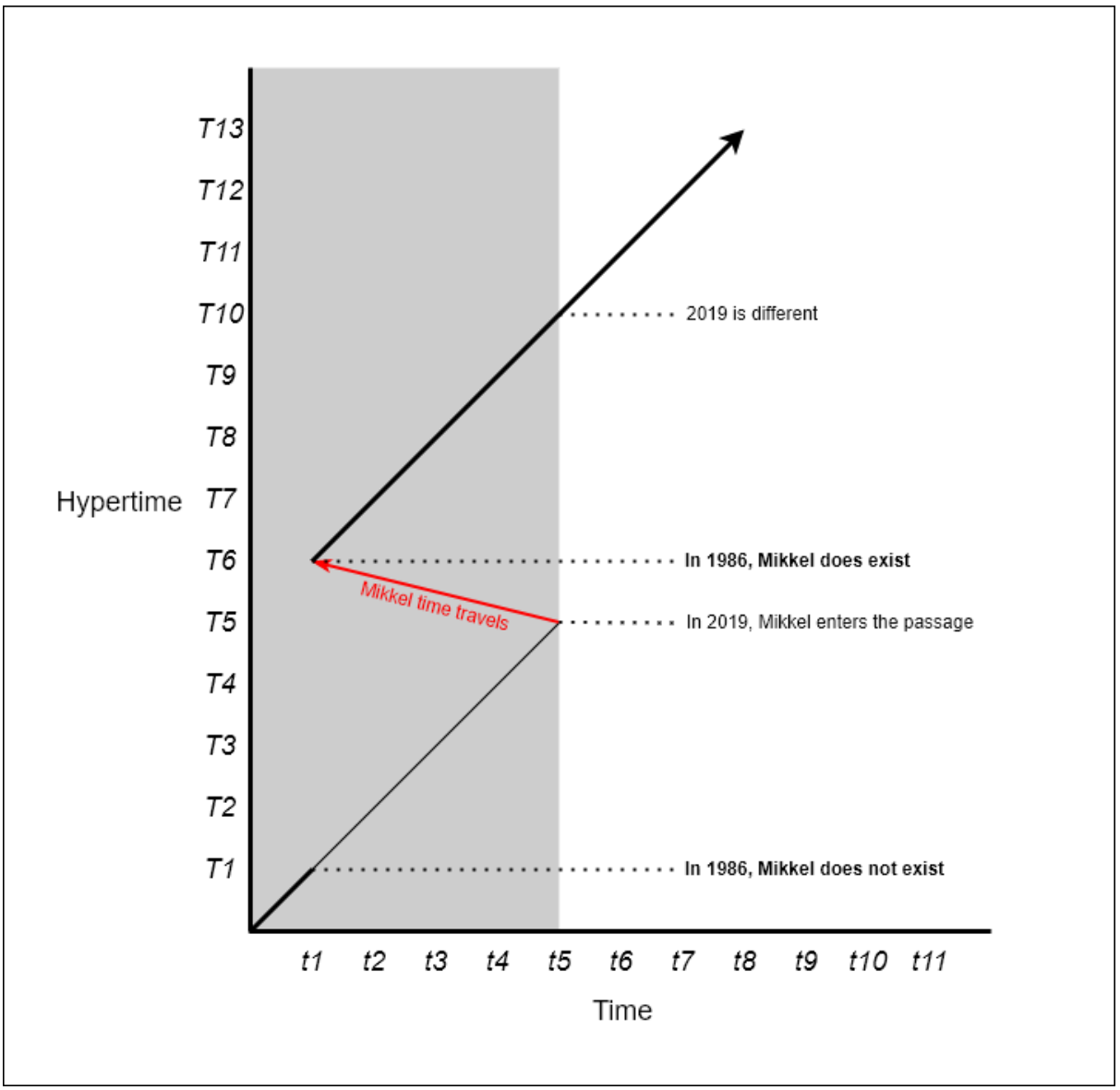


Figure 4: Two-dimensional representation of non-Ludovician hypertime travel. Note that relative to the second version of 2019 (*T10; t5*), all the shaded part is the past, and the original 1986 (*T1; t1*) has not changed. The thicker sections of the timeline are the only parts accessible to time travellers.

Note that we may imagine this hypertime travel in the same ways we imagined the previous timeline travel; positing extra hypertimes is akin to positing extra timelines. In the figures above, Mikkel is visiting the past a second time in this extra dimension of time called hypertime and rewriting the timeline from there on, which creates a different timeline just like with the previous time travel. In this case, hypertime runs along normal time, and normal time would reverse because of time travel while hypertime continues to run forward (just like you can take a video back to watch certain moment a second time while the time on your watch runs forward). This would be a universe with *conterminous* hypertime (Effingham 2020).

However, this is not the only way to imagine it. Hypertime can also be *exterminous* (Effingham 2020). That is, a whole timeline happens at one hypertime and another whole timeline happens at the next hypertime, after someone or something has time travelled. If we were a god-like creature viewing the universe from outside, or as the spectator of a story, we

would see the whole timeline—from the remote past to the distant future—in a certain way at hypertime *T1* and then a whole different timeline at hypertime *T2* due to the actions of the time traveller. Visually, it is just like Figure 2 if we imagine each timeline has a distant past and a distant future.

The result is the same, Mikkel would not exist in 1986 *at one hypertime* and would create a different timeline *at a later hypertime* in which he would exist in 1986. This new timeline, be it slightly or substantially, will be ***necessarily different*** (another Mikkel might even not be born).

1.1.4 Conclusion

We can now consider what information we obtain from the series to confirm which type of time travel fits the data:

According to Ludovician time travel, the answer to the question would be, “time travel *does not* change the past (it cannot)”.

According to non-Ludovician time travel, since the extra timelines and hypertimes are different from the previous ones, there is a sense in which we may say that non-Ludovician time travel permits some kind of change. That is, we may say that an event that takes place at a certain moment in the past may change with respect to another event at the same moment in another timeline or hypertime, but the truth is that the original event never changes (it cannot).

A few episodes in, we discover that Mikkel is in fact the same person as Michael, Jonas’ father, who we saw commit suicide in 2019, at the beginning of the series. Obviously, for Jonas to be born in 2003, Mikkel has to necessarily exist in 1986, so the future is *exactly the one we have seen* (in which Jonas is born in 2003 and therefore exists in 2019). However, both non-Ludovician options result in a different future, as we can see in Figure 2, Figure 3 and Figure 4, and must be discarded not only because of that but because different possible futures arise *every time* somebody travels through time.

We must realise that the figures I have included portray only one single example of time travel. It would be impossible to conceive of a coherent timeline if we take into account that every time traveller would be falling on or creating different timelines every single time they travel through time. If Mikkel’s example were not enough to convince us of the first option described (Ludovician time travel), we have many more and all fit the same type of time travel:

- For Helge to have scars in 1986 and 2019, and the memories of Ulrich scarring him, Ulrich has to be in the year 1953 that evolves into those future years.

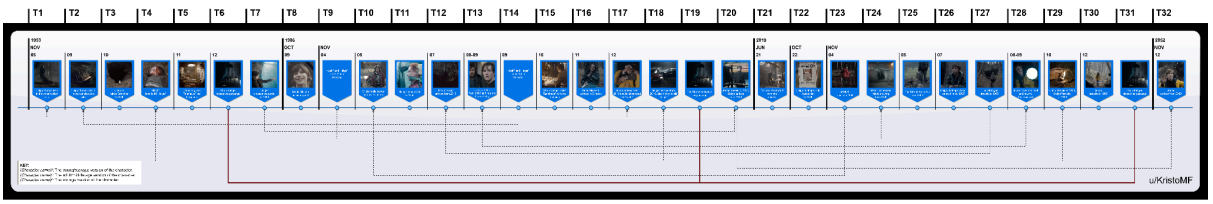
- This act of attempting to kill Helge gets him imprisoned in 1953. In 2019, Charlotte discovers an old newspaper that covers the event.

- Ulrich forgets his cell phone at Tannhaus' shop in 1953, which is necessary for H. G. to work on the time machine once Claudia shows up to give him the blueprints the day after, but he will not be able to finish it until 1986 when adult Jonas shows him the machine that is already finished.

- A time machine that Jonas needs to try and destroy the passage, which is something that Noah already knew was going to happen, as it is unavoidable.

- Noah is behind the kidnapping of Ulrich's brother, Mads Nielsen, the kid that dies travelling from 1986 to 2019, which was also already expected by Claudia.

Every new time travel we see is further evidence. We must conclude that Mikkel *does not* change the past in any sense, nor does any time traveller, and we must conclude that for time travel to be logically possible, *Dark* adopts the Ludovician option between the ones available. We can easily map out all events of season one on a single one-dimensional timeline.



[Timeline of important events in season one.]

1.2 SEASON TWO: MORE LUDOVICIAN TIME TRAVEL AND CAUSAL LOOPS

“There is no coincidence. Every path is predetermined, everything happens when it must. At the right time, in the right place. As if the world was a carpet made up of an endless network of endless threads. Each in its place. But very few of us know where the journey takes them.” -Noah

“I knew that nothing changes. That all things remain as before. The spinning wheel turns, round and round in a circle. One fate tied to the next, through a thread, red like blood, that cleaves together all our deeds. One cannot unravel the knots, they can only be severed.” -Martha

For the most part, season two just flows smoothly from season one. We see confirmation of the established type of time travel over and over again, along with astonishing discoveries. In a way that may remind of Robert Heinlein’s short story *By His Bootstraps*, Jonas, who met his future self in season one, now meets Adam, the person he will be in about 66 years. We are now witnessing conversations between three different temporal parts of the same human being.

As the series advances, it may be time to touch upon some implications of Ludovician time travel. In a universe where the topology of space-time is shaped by this kind of time travel, the future is a consequence of the past as much as the past is influenced by the future, and strange phenomena can emerge. Elisabeth can only be born because her own daughter, Charlotte, is taken to the past and can become Elisabeth's mother (see Figure 5). Jonas is born only because he leads Mikkel to the past and Mikkel can become Jonas' father. One can receive a book from the future, copy its contents, and this new copy will be the one that was received in the past; which is exactly what happens with *A Journey Through Time*, the book that H. G. Tannhaus never really wrote. The information it contains “simply exists as a consequence of the peculiar topology of the space-time manifold” (Romero and Torres 2001, 7). If eternalism is true, my future selves exist just as my past ones, and thanks to time travel one of these past selves could have received a letter from future me with orders to write that precise letter and send it back to myself!

Strange as they may seem, these chains of events that loop back in time can only be found in worlds with Ludovician time travel and are called **causal loops.**

1.2.1 What is a causal loop?

A *causal loop* is a sequence of events, each one causing the next, in a chain of cause and effect that loops back on itself resulting in the non-existence of any “first event” in the chain. Remember, *the beginning is the end and the end is the beginning.* Causal loops are created as a whole, like the circular coffee stain left on your important document when you lift the cup (such as would be the case in an eternalist universe), not in a linear fashion as we would draw a circle on paper.

Examples:

- In 1954, Claudia gives Tannhaus a copy of the book *A Journey Through Time* (a), which Tannhaus will then copy and publish (b), and years later Helge will give one to Claudia (c), who will give it to Tannhaus (a)...
- In 2019, Jonas takes Mikkel to the passage in the caves and leads him to 1986 (a), where he will grow into Michael and give birth to Jonas (b), who takes Mikkel to the passage and leads him to 1986 (a)...
- In 1987, to convince her middle-aged self, old Claudia tells her what she will see out her office window (a). Middle-aged Claudia will keep this knowledge (b) until she grows older and travels to 1987 (c), where she will use it to convince her middle-aged self, telling her what she will see out her office window (a)...
- Of course, Noah and Elisabeth have a daughter called Charlotte (a), that is taken to the '70s and adopted by Tannhaus (b). Charlotte will grow up (c), marry Peter (d), and have a daughter, Elisabeth (e), who falls in love with Noah, with whom she has a daughter called Charlotte (a)... (see Figure 5).

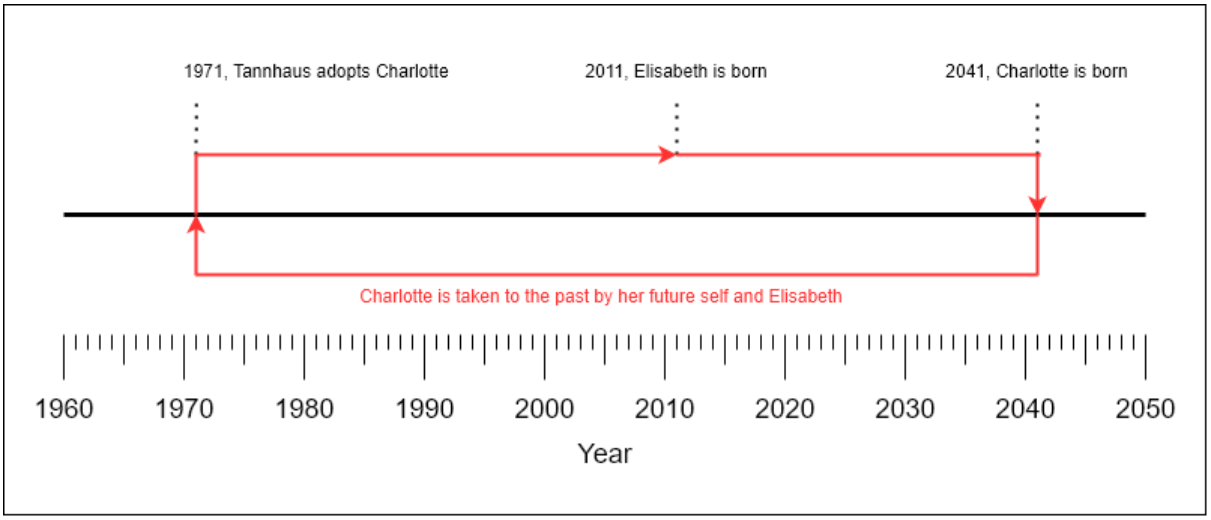


Figure 5: The Charlotte/Elisabeth causal loop.

There are, obviously, *many more* examples. Jonas and Martha's "first" kiss is part of a causal loop, and so is Ulrich scarring Helge, and Tannhaus finishing his time machine because he sees the finished time machine. And all of these causal loops may not be isolated and may be part of a massive causal loop that encompasses events across the whole show and between worlds. What could we call such a big and convoluted causal loop?

Exactly, a knot.

Regarding terminology, it is relevant to point out that causal loops are commonly known as *bootstrap paradoxes*. "Bootstrap" in honour of the mentioned story penned by Heinlein, and "paradoxes", because they have been used as another weapon against the idea of time travel. As we know, they are so strange, so counterintuitive, that it is tempting to argue that their existence is impossible and, as time travel necessarily implies their existence, time travel is impossible. But this argument, although valid, is not sound. First, time travel does not necessarily imply their existence, second, logician, mathematician and philosopher Kurt

Gödel confirmed that the existence of closed timelike curves is *theoretically* permitted, at least, as a solution to equations of General Relativity (Gödel 1949, 447-450), and third, the term “bootstrap paradox” is actually a misnomer. They imply no paradox. Maybe they are inexplicable, yes, maybe physically impossible, yes, but causal loops are logically possible and, when encountered in any story, represent a confirmation of Ludovician time travel.

Still, some experience discomfort when confronted with causal loops and insist that there has to be a “first time” in which events are not as we see in the series, denying the possibility of Ludovician time travel and implying that a different past must be created to “explain away” or “solve” the causal loop. Yet the concept of “solving” a causal loop makes no sense and stories with Ludovician time travel can include causal loops and still be consistent and coherent. If time travel is non-Ludovician, constant travel to another timeline or hypertime makes it *impossible* for the chain of cause and effect to *loop back **on itself***. It can go to the past, but not to the same past. The chain would spiral out. It would not be a causal loop.

This also means that a causal loop *cannot* form nor “stabilise” itself through non-Ludovician time travel. If we imagine that there is a “first time” in which little Charlotte is taken to another timeline, for example, or that she creates another past in a different hypertime, the first big difference with her own timeline or her own past would be her inclusion in a year in which she did not exist, and from then on differences can only grow every time the time travel repeats, creating new timelines or at different hypertimes. Although it is technically true that we could *imagine* that all your selves in future timelines have the same *exact* intentions, there are infinite possibilities in which things may be different and they necessarily all lead to different outcomes. In any new timeline or hypertime you may change your mind, or you may not be able to complete the instructions, or the method of time travel fails, etc.

If there is a “first time”, who is the girl Tannhaus adopts in this “first time”? Does he adopt anyone at all? How could he, if there can be no time travel from 2041 to 1971 in a “first time”? There would be no Mikkel in 1986 either, so there would be no Jonas, who plays a crucial role in all events. As we shall see, events in season three make a "first time" even more difficult to explain. As I mentioned before, the fact that these events may be physically impossible is irrelevant. For all we know, time travel is impossible. What matters is that these events imply no logical contradiction. To believe that one could concoct a coherent story that would finally evolve into the story we see on screen is to blatantly rely on wishful thinking. Even if it were remotely possible, it would be a different story than the one Jantje and Bo have crafted. If someone is not willing to accept causal loops, they cannot accept *Dark*.

1.2.2 Do events in a causal loop repeat over and over?

Absolutely not. As philosopher Richard Hanley pointed out in 2004, “it is a misconception to think of a causal loop as ‘repeating endlessly’. It is apparently very tempting to think that each event in a causal loop occurs more than once. This is a conceptual impossibility, however. Each event is an individual, uniquely located in space-time” (Hanley 2004, 125).

By the very nature of what a loop is, one can read the events that occur in it over and over and over and could do so forever. For example, observing Figure 5 above, we can read,

“Tannhaus adopts Charlotte, Elisabeth is born, Charlotte is born, Charlotte is taken to the past, Tannhaus adopts Charlotte, Elisabeth is born, Charlotte is born, Charlotte is taken to the past, Tannhaus adopts Charlotte, Elisabeth is born, Charlotte is born, Charlotte is taken to the past,” *ad infinitum*. But this does not mean those events can repeat because this lecture does not factor in the time at which those events occur. Once we have drawn a circle, we do not keep going round and round with the pen, and in this case, “the circle” (the causal loop) is created as a whole. There is not even a beginning or an end in the path. Along the circle, we can order events in terms of relations of earlier-than, later-than and simultaneous-with, but there is no actual present that runs along the chain going round and round.

Eternalism is an easy way to conceive of these unique events located in the 4D space-time block of the universe. However, the belief that events repeat must be discarded even if we do not believe in eternalism and consider that the flow of time is real, because we know Elisabeth and Jonas meet again in 2052. If the same events were repeating over and over, *the year 2052 would never arrive!*

Furthermore, to not make causal loops unnecessarily more complicated for ourselves, we must take care (as always) that we do not confuse the *personal time* of the time travellers with the *external time* of the universe. Adam experiences his conversation with Jonas twice in different moments of his personal time (once as Jonas and a second time as Adam), but it is *the exact same event*. The conversation only happens once. We have no reasons to believe any of our characters are born more than once due to time travel.

1.2.3 Causal loop peculiarities

Undoubtedly, a world in which causal loops are obtained is a strange one. A world that puts our common sense and our common conceptions of cause and effect to the test. Why would Michael have to commit suicide for Jonas to be born, for example? The first event is not necessary for the second to occur. That is, we can imagine other scenarios in which Michael does not die and yet Mikkel travels back to 1986, but Michael only needs to *believe* that his death is necessary to do it. He thinks he can change events, and correctly realises that in his world causality can travel back in time and some causes in the future have their effect in the past. This leads him to incorrectly believe that if he does change events—avoiding his death—, Jonas will not or may not be born. It is precisely this belief that causes him to commit suicide, oblivious to the fact that change is impossible, although if time travel were not Ludovician, that in fact could well be the case in a new timeline. What matters is that believing that the life of his son is on the line, he does not even consider trying to change things.

Similarly, some events happen precisely because the agents involved believe they have to happen. That they have to “preserve the timeline”, a timeline that nobody can change and that ironically is how it is because some believe that it has to be preserved. Others, of course, believe that change is possible and in trying to change events end up being a part of their cause.

It may seem hard to grasp how a motivation or an idea would be part of a causal loop as in these cases, and yet, on the flip side, it is tempting to ask why Noah would have to test or even build the time travelling chairs if they already have other methods to time travel. It is obviously possible that any final time travelling device could have been dropped in the past from the future; if not the actual object, at least the blueprint to build it. However, it is not necessary. We just have to accept that in this story the time machines had to undergo a technological evolution.

1.2.4 Is there a way out of a causal loop?

In the movie *Groundhog Day*, Bill Murray's character, Phil, desperately tries to escape from his time loop, a span of time that repeats over and over. As such, we can say that his consciousness is embarked in a constant non-Ludovician time travel. All he has to do is find a way to stop this constant travelling back, and somehow finally manages to escape.

The bad news is that a causal loop is not the same kind of loop, which is why we should avoid calling them "time loops". There is no way "out" of a causal loop because the past would have to change. The good news is that characters are not "trapped" by causal loops any more than we are all "trapped" by our past. This is because only *some* of a character's actions are part of a causal loop. Even Elisabeth and Charlotte, whose existence depends on a causal loop, can grow old and eventually die. If all characters would have decided to quit time travelling, then Elisabeth, Charlotte, and any other character would have been able to carry on with their lives and would not be part of any more causal loops. Unless we imagine a story with a character that appears at time *t1* from the future time *t2*, lives some time and Ludovician time travels from *t2* to *t1*. We are back at the start. This person was not born and will not die (but this does not happen in *Dark*).

The big question now is: If the past cannot change and time travel is Ludovician… How can an alt-Martha appear that neither adult Jonas nor Adam knew anything about? The only plausible answer is that Bo and Jantje included some non-Ludovician taste to the mix, raising the already very high stakes.



Timeline of important events in seasons one and two.

1.3 SEASON THREE: SCHRÖDINGER'S CAT AND NON-LUDOVICIAN TIME TRAVEL

"What is reality? Is it singular in nature? Or do several parallel realities exist at the same time? To address this, Erwin Schrödinger constructed an extremely interesting thought experiment, Schrödinger's cat. [...] Could we split time and let it run in two different directions?" -H. G. Tannhaus

As established by the law of non-contradiction, the propositions <Jonas hides in the basement> and <Jonas does not hide in the basement> *cannot* both be true in the same sense at the same time, but as we saw in chapter one, it can be logically possible if both propositions *are not* true in the same sense or at the same time.

However, the common non-Ludovician solutions we have seen apparently must be discarded, because different timelines and different hypertimes lead to different futures, and yet we see that there is only one future in Adam's world and only one future in Eva's world, and we see that there is only one past for each world (although they intertwine, because Eva remembers meeting Jonas when she was young, for example, and alt-Martha is who enables the construction of the black sphere time travel portal we see in the Sic Mundus HQ). In a hint to a possible solution, H. G. Tannhaus mentions Schrödinger's cat, a famous *thought experiment* meant as a critique of what Erwin Schrödinger thought of as an absurd notion: a cat being both *alive and dead* in a box until observed (Schrödinger 1935). A critique of the Copenhagen Interpretation of Quantum Mechanics.

To coexist with the established Ludovician time travel while adding a non-Ludovician twist, *Dark* incorporates this interpretation in some way, so contradictory propositions can be true in a different sense. It is essentially a non-Ludovician timeline travel with a few rules established to keep things coherent. These rules must be few, simple and concise, and must work for every example of this non-Ludovician time travel in the series, which is confined to a certain moment of the Apocalypse at which time stops—what they call "the loophole".

1.3.1 The three rules of non-Ludovician time travel using the loophole

Rule 1. If someone time travels *to* the loophole, upon arrival they create two states in superposition in the timeline of that world (and only of that world). This means the whole timeline and everyone in it is duplicated, except the time traveller, because they have created two states precisely by travelling to a moment of the timeline that did not include them. Two different states that would evolve into different futures, if permitted.

Rule 2. In addition, if someone travels *from* the loophole, the superposition is created upon arrival, whenever that traveller may land.

Rule 3. When using the loophole and creating two states in superposition, after an indefinite extent of time, the superposition collapses, as per the Copenhagen Interpretation. The two states do not evolve into whole timelines with different futures because one state

prevails over the other. Only one timeline (and the people in it) remains. However, if a character can "escape" the collapsing, jumping from their superposed state to another time or world, the character achieves permanence and lives on. As a result, we obtain two independent instances of the same person with independent futures.

It definitely still is non-Ludovician time travel but uses *states in superposition* as its additional indexes (see Figure 6).

<In state 1: at 2020: Jonas hides in the basement> is true.

<In state 2: at 2020: Jonas does not hide in the basement> is also true.

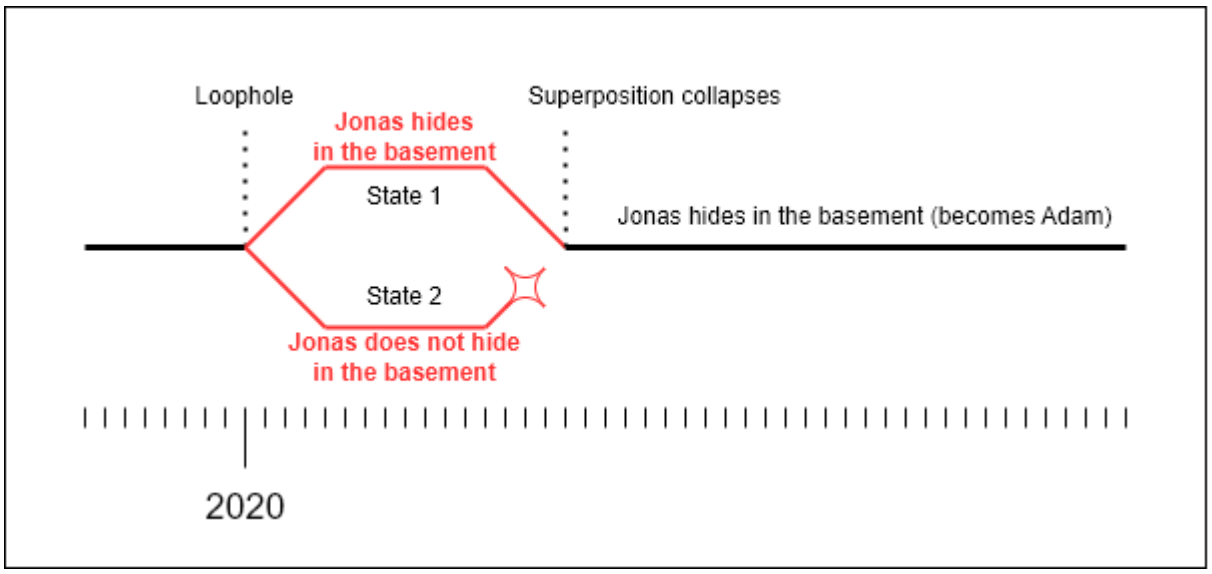


Figure 6: Superposition at the Apocalypse.

1.3.2 How many superpositions are created?

The short answer is *five*: three in Adam's world and two in Eva's world. I will break them down in the order we see in the series and include this link to a summarised timeline centred on the loophole, which might make it easier to comprehend.

1.3.2.1 In Adam's world

Alt-Bartosz's superposition: This is the only instance that apparently follows rule 1, and is quite straightforward. Alt-Bartosz departs from an unknown time, presumably from Eva's world, and arrives in Adam's world at the precise moment of the loophole, creating two states in superposition.

Now we have a state in which alt-Bartosz takes alt-Martha(1) (who will become Eva) and another state in which alt-Martha(2) takes Jonas(2) to her world. When the superposition collapses, the first state prevails, Jonas(1) (who hides in the basement) grows to eventually

become Adam, while Jonas(2) and alt-Martha(2) survive the collapse because they travel to Eva's world.

Note that alt-Martha's journeys are Ludovician (she does not use the loophole), so both her arrival in Adam's world and the arrival of alt-Martha(2) and Jonas(2) in Eva's world are not creating different timelines. She arrives on the only timeline there is.

Claudia's superposition: On the day of the Apocalypse, Claudia waits for the moment of the loophole and then jumps *from* the loophole to 2053, creating the superposition upon arrival, after Adam kills alt-Martha(2) with his "twin-apocalypse machine".

We have one state without Claudia, where we can infer that Adam(1), after killing alt-Martha(2) and discovering that his plan is a failure, decides to go to shoot and kill Eva (and perhaps commit suicide afterwards?). We do not get to see all of this, it is only mentioned. What we see is the state created by Claudia and that includes her, where she appears to take Adam(2) to the burnt Sic Mundus HQ before the superposition collapses and then explains her discovery and her plan.

Adam(2)'s superposition: To avoid Adam(2) encountering alt-Martha, I suppose that alt-Martha arrives some moments prior to the loophole (let us say twenty seconds) and that knowing this, Adam(2) waits until the precise moment and then jumps *from* the loophole, say thirty seconds to the past (ten seconds before alt-Martha's arrival), to create the superposition there.

Alt-Martha does not appear in this state because this state does not prevail. The Jonas of this state, Jonas(3), does not disappear with the collapse because he leaves with Adam(2) to Eva's world. Once in Eva's world, Adam(2) tells Jonas(3) that a loophole also exists there and that they must use it (this makes it quite obvious that creating a superposition in one world does not affect the other).

Just as with alt-Martha above, this time travel is also Ludovician. They do not use the loophole to travel to Eva's world, and as a result, Adam(2) and Jonas(3) are part of that world's timeline. They "always" were.

1.3.2.2 In Eva's world

Adam(2)'s superposition: As mentioned, there is no timeline in which Adam(2) and Jonas(3) do not exist in Eva's world on the day of the Apocalypse there. Once Adam(2) has explained his plan to Jonas(3), he heads into the caves and to the Erit Lux HQ, where he burns the paintings. He then uses the time machine there to jump *from* the loophole to 2052, to a moment before Adam(1) arrives to kill Eva. Creating a superposition, there are now two Evas, Eva(1) is shot but he can talk to Eva(2).

This means that Eva (before superposition) has believed for years that the Adam that would come to kill her, Adam(1), was the one responsible for the burnt pictures, but he was not, it was this Adam(2) she knew nothing about.

Jonas(3)'s superposition: Meanwhile, we do not see this, but Jonas(3) uses the loophole jumping *from* it to the woods nearby, creating a superposition so he can take an alt-Martha(3) away in front of a Magnus(2), a Franziska(2) and an alt-Bartosz(2). This state will obviously not prevail, but Jonas(3) and alt-Martha(3) are safe in Adam's world, in 1986, where they “always” were. This last jump is Ludovician, of course. If anyone had entered the caves that day they would have found Jonas(3) and alt-Martha(3) there, waiting for the incident.

All these examples work, but after this explanation, the question that might linger on, unanswered, is *what makes one state prevail over the other?* We could chalk this up to a matter of luck, or quantum indeterminacy, but we may suppose that this is just another manifestation of the universe existing as a whole block universe. If the state in which Jonas hides in the basement did not prevail there would be no Adam. The story is how it is precisely because of which states prevail. And it is important to note that the fact that the loophole can create superpositions and duplicate characters does not void or contradict all the eternalist or Ludovician framework already explained. Past and future both exist. Alt-Martha and Jonas see as children what is inevitably going to happen in their personal futures. There is nothing “new”.

1.3.3 Why am I assuming that characters travel between worlds using *time* travel?

One may think that I am somehow cheating with this assumption; that characters suddenly appear in one world from the other and as such this should not be considered as time travel, and is not obliged to follow the same rules. The first part is true, we are not required to treat their journey as time travel, but the consequences are necessarily the same and so we can apply the same rules.

On the 4th of November 2019, alt-Martha and Jonas appear in the caves in Eva’s world from another world. This proposition is true, and no contradictory proposition is true in any other sense or at any other time. There is no “other” 4th of November 2019 in Eva’s world in which that does not happen. Eva remembers it. The event is unavoidable and happens, just like alt-Martha being born in 2003, and just as all other events happen. Hence, it is just as if they had used Ludovician time travel.

What would have happened if they would have travelled from one world to the loophole of the other world, or from the loophole of one world to the other world, or *from one loophole to the other loophole*? Unfortunately, we do not know, but I believe it is quite safe to assume that the loophole rules would still apply.

1.4 FINALE: HYPERTIME TRAVEL

“There is a way to destroy the knot. Through preventing the invention in the Origin world of travel through space and time in the first place.” -Claudia

We know that in the Origin world, Tannhaus builds a time machine because his son Marek, his daughter-in-law Sonja and his granddaughter Charlotte die in a car accident. So the proposition <In the Origin world: at 1971: Jonas and alt-Martha do not exist> is true, and yet, in the finale, we see that a contradictory proposition is true, <In the Origin world: at 1971: Jonas and alt-Martha exist>. This is a blatant contradiction, so we must resort to our familiar solutions, assuming that alt-Martha and Jonas *time* travel to the Origin world for the same reasons as stated in the previous chapter.

Ludovician time travel? This is clearly not the solution. Ludovican time travel cannot make two contradictory propositions both true in any way, so if <In the Origin world: at 1971: Jonas and alt-Martha do not exist> is true, that is what happens. Ludovician time travel cannot change that fact in any other sense or at a different time. What is more, if the contrary were true, i.e., <In the Origin world: at 1971: Jonas and alt-Martha exist>, that would mean that Jonas and alt-Martha were there in the Origin world in 1971 in the first place and it would have been the solution if alt-Martha and Jonas had caused the accident, or if they had helplessly witnessed it. This is not what happens (although some would have preferred it).

Non-Ludovician time travel? As we know, this would mean that <In the Origin world: at 1971: Jonas and alt-Martha do not exist> is true and that <In the Origin world: at 1971: Jonas and alt-Martha exist> is also true, albeit in a different timeline or at a different hypertime, or resorting to the superposed states we have already seen.

This means Jonas and alt-Martha’s time travel to the Origin world is non-Ludovician. The commonly proposed solution is the different state index, which clings on to the “Schrödinger’s cat” explanation we heard in season three because it worked in Adam and Eva’s worlds. However, this *is not* what we see. We have seen it work several times and it never entails a contradiction. In this case, it cannot be the solution, not only because it entails a logical contradiction, but because it also contradicts *what we see on the screen*.

Let us suppose that the loophole rules apply, so we have the superposition:

- <In the Origin world: at 1971: in state 1: Jonas and alt-Martha do not exist>
- <In the Origin world: at 1971: in state 2: Jonas and alt-Martha exist>

Can both be true? Sure. No contradiction. But once the superposition collapses only one state prevails—only one timeline remains—and the result is a contradiction (see Figure 7).

<At 1971: timeline 1 remains> is true (because Adam and Eva’s worlds exist for Jonas and alt-Martha to exist and create the superposition), and

<At 1971: timeline 2 remains> is *also* true (because Adam and Eva’s worlds do not exist, as we see the worlds disappearing).

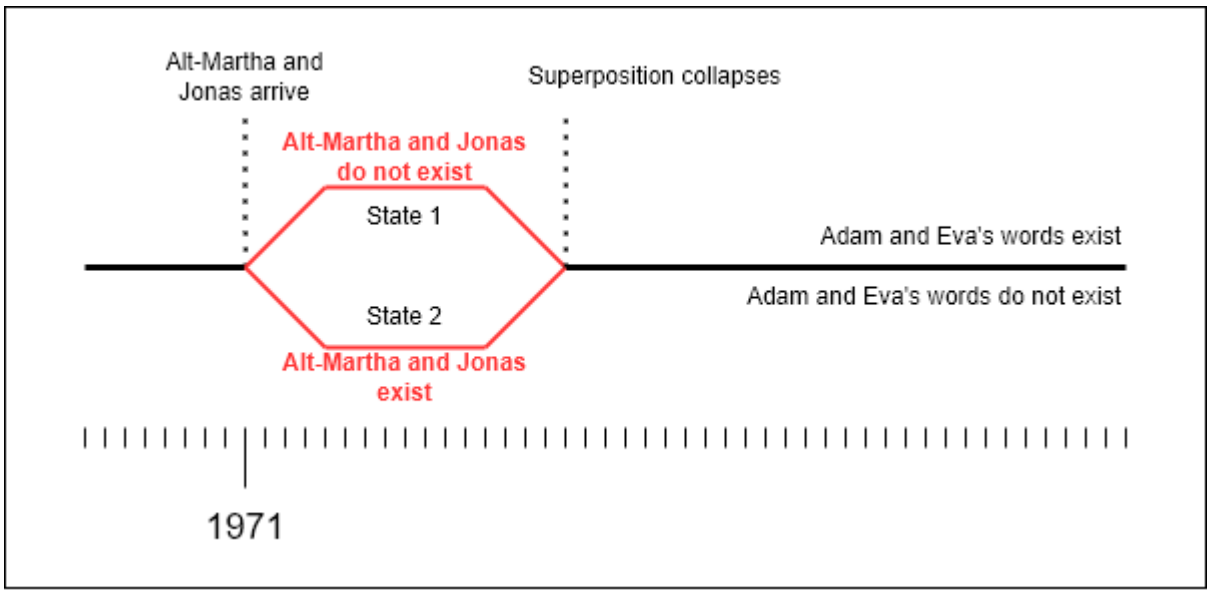


Figure 7: Contradiction in the collapsing.

In other words, if state 1 prevails, the timeline remains in which Adam and Eva's worlds don't disappear, but we see them disappear; if state 2 prevails, the timeline remains in which there is no Jonas and alt-Martha to create the superposition that we are supposing.

We can forget about the loophole rules and about collapsing and resort to a superposition that results in *different* timelines to solve this. This supposes that alt-Martha and Jonas do not exist in one timeline and exist in another, but that would mean Adam and Eva's worlds still exist in the timeline from which alt-Martha and Jonas came and do not disappear (see Figure 8). It does not work because we see them disappear.

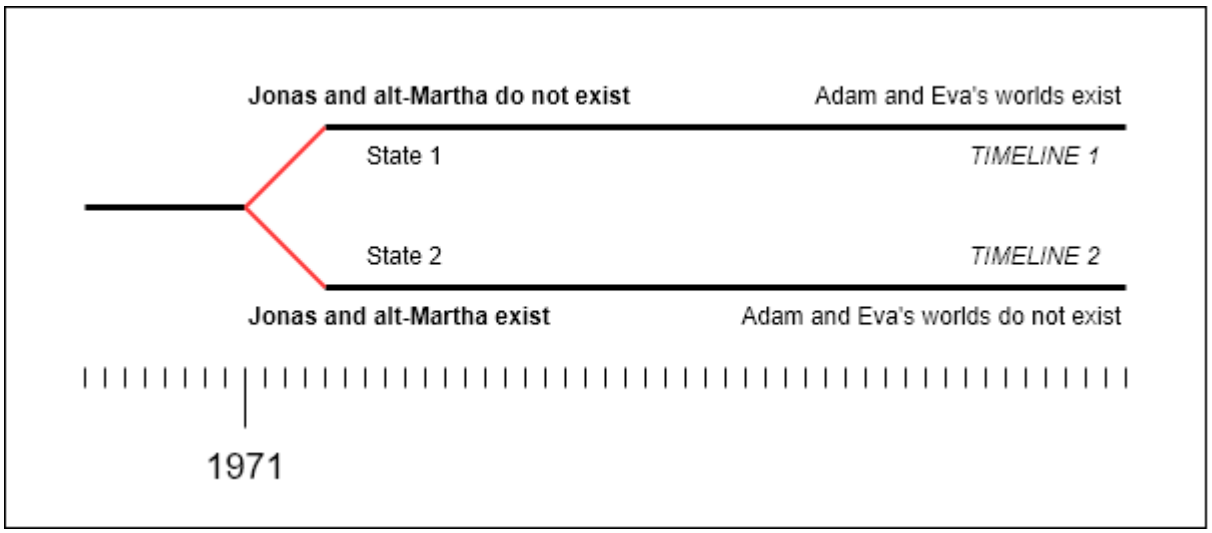


Figure 8: Solution to the contradiction in the collapsing.

I cannot stress this enough, we do not see any quantum superposition, Schrödinger's cat or "observer" collapsing in the Origin world; no Jonas and alt-Marta existing and not existing in superposition. To respond to this last statement with "the knot disappears because alt-Martha and Jonas save Tannhaus' family" is to admit there is a clear *linear* causation: *first* Marek dies and Tannhaus creates the knot, *then* alt-Martha and Jonas exist, appear in the

Origin world, and make the knot disappear. Discarded superposition and different timelines, we turn elsewhere.

1.4.1 The hypertime solution

In this case, Jonas and alt-Martha's journey is a hypertime travel. They are a consequence of Tannhaus starting his machine in 1986 in the Origin world and must appear in a "next" 1971 in the same world for both contradictory propositions to be true in the same sense but at a different hypertime (see Figure 9).

<In the Origin world: at hypertime *T1*: at *t1* (1971): Jonas and alt-Martha do not exist> is true.

<In the Origin world: at hypertime *T6*: at *t1'* (1971): Jonas and alt-Martha exist> is also true.

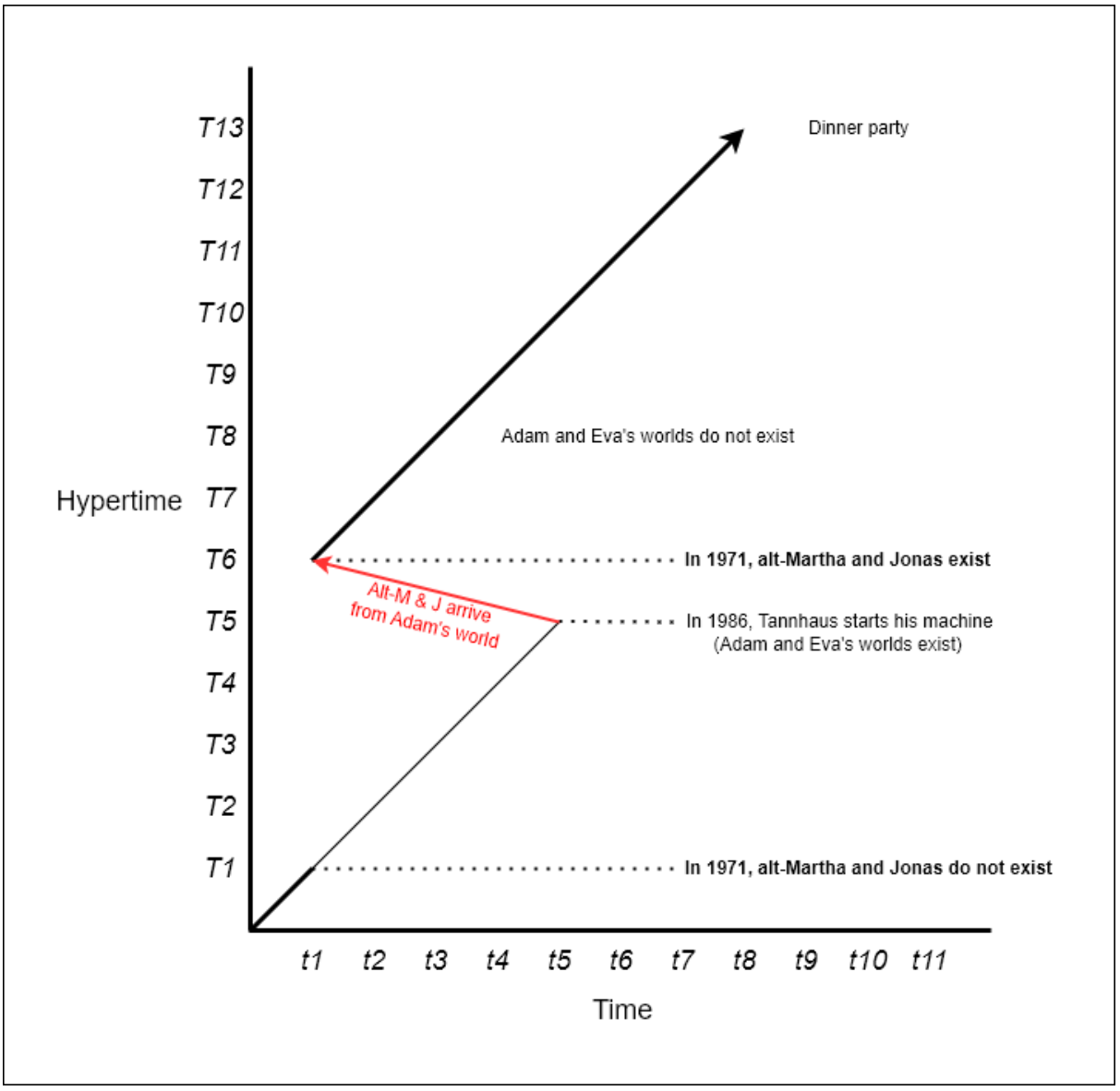


Figure 9: Non-Ludovician hypertime travel to the Origin world.

For now (praise hypertime!), this solution seems to do the trick, and we do not have to suppose that time or physics work differently in the three worlds, which would be inconsistent and arbitrary. We do not have to suppose that the Origin world is somehow presentist, or a growing block, and we certainly do not have to suppose that characters are magically and suddenly granted free will (which I will talk about in the next chapter). No, none of that. All is written, all is laid out. Just like the "wardrobe scene" in the tunnel of light—the children see the future that already is (in Figure 9, we can imagine this event lies eternally somewhere between *T5;t5* and *T6;t1*).

About the tunnel of light, it may be interesting to point out that while considering hypertime, causality still follows the arrow of time. Many may be curious about how the year 2053 could possibly exist, even in a block universe, if alt-Martha and Jonas hypertime travel from 1986, cutting short the future of their worlds. Perhaps the tunnel of light is the solution. When inside it, Jonas and alt-Martha may be "between worlds", travelling forward in time to the end of these, until a moment past the year 2053, when they *then* use the sphere and hypertime travel back to the Origin world (as I represent in my timeline below).

Alas, this inevitably runs into a problem because Jonas and alt-Martha's appearance immediately creates a different past, and yet in the series we see that Adam and Eva's worlds do not disappear *until* Marek has driven off back to his father. Not only that, but alt-Martha and Jonas also disappear. This is awfully troublesome. But I want to end this part on a positive note, so I will deal with it later, in part 2.

Finally, let me point out that this final type of time travel is best reserved for one single and last jump anyway. As Nikk Effingham put it, "This is a depressing form of time travel since it 'kills' everyone you leave behind by cutting short their futures" (Effingham 2020, 77). As stated in the first chapter, when travelling back in ordinary time and creating a different past at a later hypertime, you are making a part of the timeline inaccessible—in some sense, it disappears. So even though past hypertimes still exist and a, say, hypertime historian—an observer from outside this multiverse—could say that those worlds exist at hypertime *T1*, they are no longer there for the inhabitants of the Origin world.

These can now live on and have dinner parties in which they might reminisce events lost in hypertime.



Timeline of important events in all three seasons.

TL;DR

1. *Dark* displays Ludovician time travel: characters travel to a past that already includes their existence. Time travel cannot change the past nor create different futures.

2. We encounter causal loops, further proof of Ludovician time travel. Most importantly, each event in the series is unique and only happens once.

3. The loophole adds some non-Ludovician flavour to the mix and permits the creation of two superimposed states during a short period. This enables characters to duplicate but does not mean anything changes, as is confirmed by Jonas and alt-Martha seeing themselves as children in the tunnel of light.

4. The journey to the Origin world appears to be another version of non-Ludovician time travel. There is no superposition but linear causation: *first* Tannhaus' family dies, *then* alt-Martha and Jonas appear and save them, making the knot disappear. It runs into a problem I will detail in part 2.

PART 2.

2.1 FREE WILL

“It is human nature to believe that we play a role in our own lives. That our actions can change things.” -H.G. Tannhaus

“We can indulge in the illusion of free will if we want, but we cannot escape our ultimate destiny.” -Eva

I have been talking about propositions again and again as if they were in every case *timelessly* true or false. For example, I stated that season one establishes that the proposition <At 1986: Mikkel exists> is true, and always true. Confronted with that, we may have thought, “Wait a minute, if propositions are timelessly true or false, and the proposition <I will not eat a hamburger before next Monday> is true, that means that I cannot eat a hamburger before next Monday, even though I really want one. F**k."

The question is, “*why* can I not eat a hamburger before next Monday?” Well, there are an enormous amount of *plausible* reasons for this, but I need to stress the “plausibility” of the reasons because this need not imply some supernatural time force or magical time correction power. There is *no need* to shift into a realm of fantasy.

Let us assume that said proposition, <I will not eat a hamburger before next Monday> is true. We have many easy reasons at hand for why this is, depending on whether I decide *not to* have one or I do: I may not feel like eating a hamburger, or I may prefer to eat something with fewer calories, or I may not have the money, or I may not have the time or the means to get to the place, or I may end up in a hospital, and a long etc. I might even be kidnapped! But no magic and no God Hand required.

What difference will it make if a Ludovician time traveller comes and tells me that I will not eat a hamburger before next Monday? Well, either I simply will not care, or I may actively want to prove them wrong. However, we already listed some reasons that will prevent me from eating a hamburger *even if* I decided I wanted to and *even if* I wanted to prove the time traveller wrong. There are many times we do not achieve what we desire. So even if Jonas actively wants to take Mikkel back with him from 1986 to 2019… Well, tough luck, Jonas, you are in for a disappointment. If information coming from the future is part of the past, then the future is as it is *precisely* because of that information. In any case, it cannot change.

2.1.1 If everything is “set in stone”, what about free will?

If we are not willing to give up free will altogether, we have to accept that the character’s “free choices” are set in stone with everything else. However, whatever the case, the fact is that *nobody can choose something other than what they choose.* Let that sink in. There is no more to it, but in the end, here is the little secret… *Free will is a red herring.*

Many get hung up on it because free will is something many take for granted or that some may struggle with, as the characters in the series do. It may be great to find a relation between character’s beliefs and the ideas of famous philosophers (such as Schopenhauer

and Nietzsche), but we must not put the cart before the horse: free will, or the lack thereof, has *no bearing on the possibility of changing events in the timeline*. As established, the past cannot change. This is not a consequence of there not being free will, it is so because it is logically impossible for the past to change.

2.1.2 *How* would the characters act differently if they *did* have this magical free will?

Think about it, the answer to this question cannot be “If they had free will they would be able to choose differently." That is not possible, because any choice they make **does not happen more than once** in order for them to choose otherwise. Any choices they make are part of the past or part of the future. There is no second chance.

For example, Ulrich—when following Helge into the passage in season one—chooses to go left and ends up in 1953. *That is the* **only** *time he chooses*. He chooses once, and decides "left". Full stop. If this is not a real choice, or if this precludes free will, then so be it. Again, either we believe that those choices are a manifestation of the free will they have, or we discard the notion of free will altogether. Full disclaimer: I choose the latter. Eva and Claudia apparently accept this too.

Now beware. The fact that Jonas and alt-Martha succeed in creating a different past in the last episode *does not depend* on them having free will, *nor does it* imply that they now have free will in the Origin world. Free will has nothing to do with it, and positing that there is no free will until suddenly characters gain free will in a certain moment of the show is willing to accept that “suddenly magic”. There is no reason to suddenly shift the ontology of time or the physics of the universe. The death of Tannhaus’ family is written in the fabric of space-time, just as the fact that he creates two universes, that Jonas and alt-Martha are born, and that they succeed in avoiding the death of the family to create a different future with no knot. This is an event just as inevitable as all the previous ones and I have attempted to explain why in part 1, following the time travel options available.

2.2 WHAT'S IN A NAME?

This takes us to a discussion about labels I mentioned at the very beginning of part 1 when I said that other names for the Ludovician time travel are "self-consistent time travel", or "deterministic time travel". I also implied that the Ludovician label was more accurate, and here is why.

2.2.1 Self-consistent time travel

Let us start with the "self-consistent" time travel, called this way thanks to Russian physicist Igor Novikov's self-consistency principle. The principle asserts that if an event exists that would cause a paradox or any change to the past whatsoever, then the probability of that event is zero (Friedman et al. 1990, 1915-1930). It would thus be impossible to create time paradoxes.

I understand this label only refers to Ludovician time travel, i.e., time travel that assumes that the past cannot change in any sense. However, it can be argued that *all* time travels in *Dark* are paradox-free (except the last one), so technically the label could be applied to all of them, hindering its usefulness in differentiating one from the other.

2.2.2 Deterministic time travel

This is also commonly used to refer to Ludovician time travel. However, "determinism" describes how the *universe* works, not how time travel works. So if Ludovician time travel is this deterministic time travel, what should we call non-Ludovician time travel, which takes place in the same universe and therefore would also be deterministic?

The answer to this may be that determinism breaks down at the loophole, for example, but there is another problem: we can distinguish between three kinds of determinism, so the label can be confusing. Ignoring epistemic determinism, which is very similar to logical determinism, we still have two: *logical determinism* and *causal determinism* (the latter being the determinism normally invoked).

Causal determinism states that what one does is the result of the Laws of Nature, one's physical and genetic makeup and one's personal history. If there is any randomness working at the subatomic level, that would mean causal determinism is false. But this is irrelevant. Ludovician time travel, the one often called "deterministic", would work *even if* causal determinism were false. Past and future already exist, and the fact that the laws of physics have random elements or not is irrelevant. The timeline is how it is, deterministic or not. This is just like the point I mentioned before when talking about free will: characters do not get to choose more than once; they do not have an opportunity to act in a way other than how they act. Their actions are part of an immutable past and future. So why call it deterministic if the universe might not be deterministic?

A response to this may be that “deterministic” time travel refers to a time travel in which everything is “determined”. That means that the determinism here is **logical determinism**, or fatalism, which states that propositions are timelessly true or false. As we have seen, this is what I have applied consistently throughout the essay, and so, again, I would argue that *all* kinds of time travel in *Dark* are deterministic *in this sense*, so the label is not useful for distinguishing them either.

To conclude this chapter, I must repeat, just to be clear, that there is no reason to suddenly shift the ontology of time or the physics of the universe and to posit that the Origin world is not deterministic. The Origin world might be just as causally deterministic as Adam and Eva’s worlds, or maybe none of them are.

2.3 THE GRANDFATHER PARADOX

“An infinite chain of cause and effect that repeatedly leads us to our same fate in both worlds. We do not have the free will to act in either world. We will forever do what we have always done before.” -Claudia

“Both of our fates are bound together in eternal damnation across both worlds. Jonas and Martha must go to the Origin world and prevent our two worlds from ever being created.” -Adam

It may seem strange that I have not mentioned the Grandfather Paradox yet, not even once, and I regret that I have to because of what it implies. Ideally, everything said up to now should cover all that is needed for the series. The Grandfather Paradox is also an argument for the impossibility of time travel due to a contradiction obtaining, but focuses on the idea of the contradiction occurring *after* the time travel has taken place; so if someone clearly understands the contradiction that arises by the mere action of time travel and the options available to solve this contradiction, the Grandfather Paradox does not even have the chance to show up and pose a threat to the (logical) possibility of time travel. And yet, it is very easy to be persuaded by it just as it is by the idea of free will.

2.3.1 “If I *can* travel to the past, I can *surely* kill my grandfather before he meets my grandmother.”

This idea stems from a profound misunderstanding of Ludovician time travel and its implications. Still, it is tempting to imagine scenarios in which we time travel to the past and “kill our grandfathers”, or the other way round, save people whose death is necessary for us to exist in the first place. And what happens next? Should we just disappear?

No, those scenarios are simply logically impossible. Nothing can “happen next” because it cannot even happen and, as I have stated before, there are obviously an enormous amount of *plausible* reasons why it cannot happen. The fact that we are alive *proves beyond any doubt* that our grandfather did not die before meeting our grandmother. At least, the grandfather who lived in the past that evolved into our present. Of course, with non-Ludovician time travel, it is actually possible to kill grandfather as many times as we like. Why? Because the grandfather of our actual past remains untouched. It does not affect us.

In the same way, they may save Tannhaus’ family as many times as they like. Even when creating a different past for the Origin world in a later hypertime, their original past remains untouched in a previous, inaccessible, hypertime, as stated in part 1. It does not affect Jonas and alt-Martha.

Unfortunately, this is not what we see. It does affect them. They both disappear.

2.3.2 Why do alt-Martha and Jonas disappear?

As we saw in part 1, hypertime travel is the logical solution for the couple to appear in the Origin world, in 1971, and create a different past for it in which Marek and his family do not die. “A different *past*” because we must remember that the Origin world has an existing period between 1971 and 1986, in which Tannhaus builds his machine. This period should “disappear” as soon as Jonas and alt-Martha appear in the Origin world and, *if* it were logical for them to disappear with it, they should do so with the journey, *not* minutes after.

We may suppose that this is because upon arrival they have not prevented the accident *yet*. But that is irrelevant. Even if they did not prevent the accident at all, and Tannhaus’ family died again, and Tannhaus created a new machine again, and alt-Martha and Jonas were born again, this “again” I am inevitably including implies that they would be a numerically different couple (let us say alt-Martha(2) and Jonas(2)). Whatever happens to one of the alt-Marthas and Jonases *cannot* affect the other; just like in the series Jonas(2) dies and Jonas(1) keeps on living, so even though there will not be another alt-Martha and Jonas now that Tannhaus has his family back, the alt-Martha and Jonas who are the cause of this should live on.

So their worlds must disappear whether they prevent the accident or not. They create a different past upon arrival, and as such, they are part of the “rewriting”. What we see on screen, the worlds (or only the characters) slowly disappearing, although flimsy, can be chalked up to an artistic licence for an emotional impact, but the fact that alt-Martha and Jonas also disappear is outright illogical. It simply does not work.

Furthermore, it is not true that it makes sense that they disappear “because their worlds disappear”. That is akin to saying if you kill your grandfather before your grandfather meets your grandmother you disappear “because you are born thanks to your grandfather meeting your grandmother", which is, again, falling into the Grandfather Paradox and imagining an impossible scenario.

It may be even worse because it is possible to see the show and just intuitively accept that what happens is logical. The problem may be precisely because Jantje and Bo chose *to wait* to show the worlds disappearing, and that implies that the cause is that alt-Martha and Jonas prevent the accident, or that they should disappear with their worlds when logically *the cause is their appearance in the Origin world*. Once one is misguided into believing that preventing the accident is the cause, accepting that the couple also disappears is kind of trivial for the viewer. This leaves me wondering if the decision of waiting for everything to disappear really was just for the emotional impact, or if they actually intended it to be that way (which is akin to time travel in *Back to the Future*), and I am vainly trying to swim upstream, attempting to give a logical solution instead of accepting that they simply did not care.

In a 2019 interview for vulture.com, Jantje explicitly stated the following, “We very strongly feel that art should not be explained. As long as we understand and know the logic behind it and we don’t fool ourselves, we’re fine. And maybe it will take time for some people to understand why something isn’t a plot hole after all. I think discussing such things takes the

mystery away, and it's supposed to be an adventure. You are supposed to wrap your head around it and try to figure out how this works. And if you need secondary literature — great!"

I agree, discussing such things is great fun, but I do not see the logic behind it. Although this was before season three when everything was solid. I fear that her husband foresaw the future when he states in the same interview that "of course there are plot holes".

Alas, let us follow on because I have a second complaint regarding the misunderstanding of the Grandfather Paradox, which leads us to my second grudge with the series: its terribly misguiding explanations.

2.4 A MÖBIUS LOOP

Let us return to the Grandfather Paradox for a moment, for there is a further misunderstanding of it that can lead us down another illogical rabbit hole. As stated in the last chapter, when misconstruing Ludovician time travel and its implications, it is tempting to imagine scenarios in which we time travel to the past and actually “kill our grandfathers”. In our context, this is akin to imagining Jonas and alt-Martha appearing in the Origin world and saving Marek and his family *in their actual past*. When talking about these scenarios I asked, “What happens next? Should we just disappear?”

I restate that those scenarios are illogical, but apparently, it is also tempting to answer those questions in the imagined scenario with something like, “Yes, Jonas and alt-Martha disappear. **In turn**, Tannhaus’ family dies, and the couple is born again to go back and save Tannhaus’ family again, so they do not exist, and Tannhaus' family dies again, and so on *ad infinitum*.”

This is plainly absurd, there would be no “in turn”, and it is meant to be absurd to point out how it is impossible to change the past. This chain of events is not meant to be taken as actually possible. We have seen that *if they can save Tannhaus’ family,* it will be visiting the past a second time and creating a different future, so a new alt-Martha and Jonas will indeed not exist, but Tannhaus’ family is saved, and it ends there. They will not "die again" *unless* someone else goes back in time to prevent Jonas and alt-Martha from saving them.

This nonsensical sequence of actions is even worse than the one I described when talking about the misconception that leads to believe that the events of a causal loop repeat over and over because at least all events in the latter are causally connected (in fact, that is why it is called a *causal loop*). But the events described above are not. After all, if the couple disappears because they have saved Tannhaus' family, the family cannot die again in the same way at the same time. Nevertheless, this mistaken idea of the Grandfather Paradox can sometimes be found mapped onto an infinity symbol (see Figure 10) or, more specifically, on a Möbius loop, a surface with only one side that loops around.

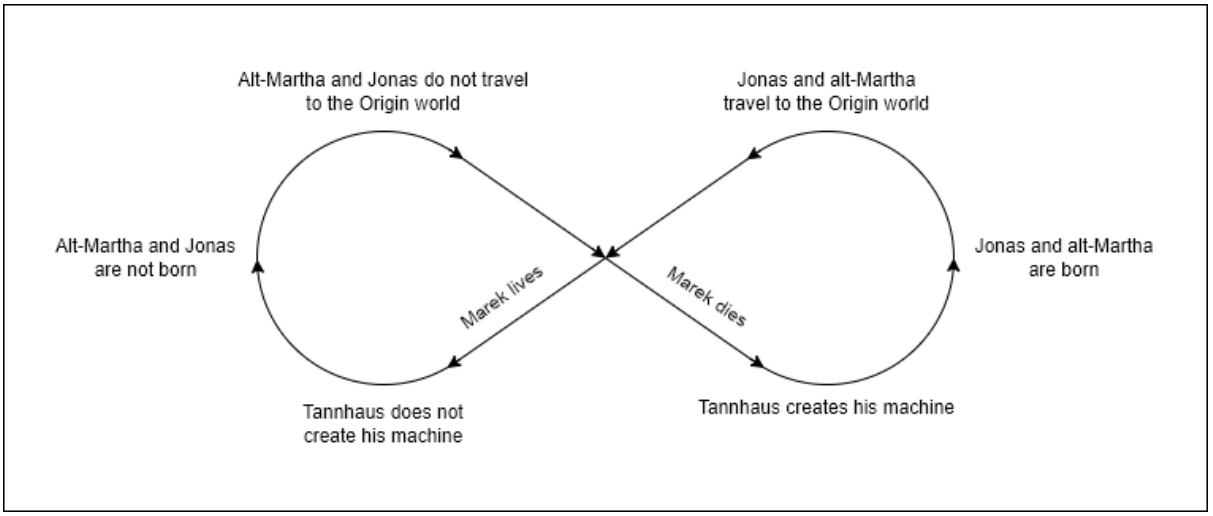


Figure 10: Mistaken idea of the Grandfather Paradox. It is not to be taken as an actual sequence of events, but as the impossibility implied in changing the past.

The only sensible way an infinity symbol or a Möbius loop *can* be used to map out events is when those events are part of a causal loop. After all, “The beginning is the end and the end is the beginning,” and I would like to be able to confidently affirm that this is what Eva does when drawing one on the sand but, as I said, my complaint is with the misguiding explanations in the series.

Eva refers to it as “The switch point at the junction in the loop of time. The moment that allows things to run in one direction or the other. You bring him to our world or you don’t. A line that meets itself in a loop. Two possible paths: along the outer edge of the line, or along the inner edge of the line. And yet it is the same line. Two overlapping realities. On one of these paths, he dies. On the other, he doesn’t. Both possibilities recur in the loop again and again. One triggers the other. Quantum entanglement.”

Starting at the switch point, we could assume the right part describes events that occur in Adam’s world and the left in Eva’s world, and begin:
Jonas hides in the basement, becomes Adam, and kills Martha. But before that he sent her to 1888, so we can start with Sic Mundus and through events in Adam’s world until 2020 and the Apocalypse, but now we follow Jonas to Eva’s World, where he dies, and Martha becomes Eva, who is killed by Adam. Her corpse is discovered by her younger self, whose actions have effects back in the past, so we will have more links in the chain of cause and effect across all years in Eva’s World until Eva sends Bartosz to Adam’s World, and we are back at the start: Jonas hides in the basement (see Figure 11). And I must insist, *this must not be understood as if these events occur more than once.*

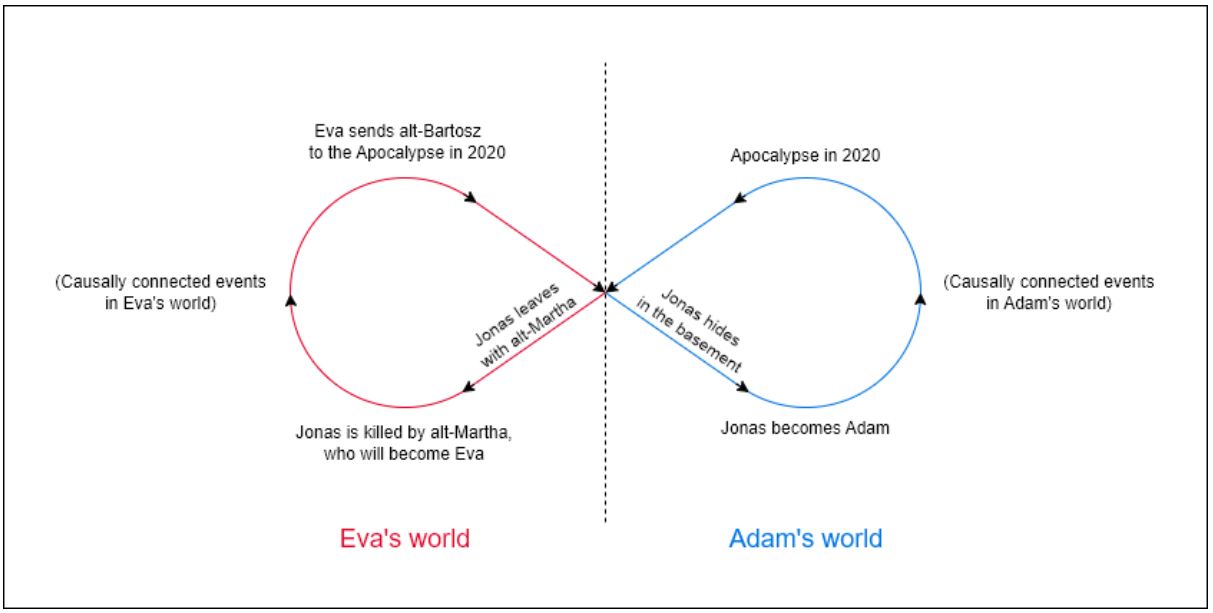


Figure 11: A causal loop between worlds.

Is this what she means? It does not seem so. Maybe what she says is not meant to be an accurate description, just a rough metaphor for what happens at the loophole. Yet I am absolutely sure that many of you understood something different than this, which makes my point: I find her explanation quite unsatisfactory. What does she *actually mean*?

And even though we may argue that this is on purpose because it is left up to interpretation and that that is something some may like about the show… I honestly do not. Yes, the discussion is great, but I really like to know what is going on. We do not know much about the past or fate of many characters, such as Agnes, and that is fine, but this—the *how*, the *why*—is important. This leads us to the last chapters.

2.5 THE ANGEL OF DEATH

Finally, we get to what may be the biggest thorn in my side and the source of most of the confusion I encounter about the series. Claudia, our saviour, shows up, unexpectedly, having used the loophole to create a superposed state in which she meets with Adam before going off to bury the machine and die at the hands of her great-grandson, Noah. Claudia is the detective that has solved the case and that will give us all the solution. Except, unfortunately, she does not explain how she discovers it. The explanation she gives does not explain anything; what is worse, it is only misleading.

2.5.1 The vacuous explanation

Claudia says, "I've spent 33 years looking for answers in your world and in hers. I've tried to put together the pieces of the puzzle, to understand how everything can be reborn from the same family tree over and over again. Until I realised that we're not all part of the knot."

Realising some people are not part of the knot is child's play. *Obviously,* not everybody time travels; the characters born due to the knot are only a small portion of all the inhabitants of Winden, and a meaningless fraction of all the humans on Earth. We as spectators are fixated only on the characters in the show, but that must not blind us. This first part tells us nothing.

She continues, "Both worlds are a cancer that must have grown from something else. If you remove it, you destroy all that was born of it, but you keep everything alive that already existed in the Origin world."

Here she is explaining what she thinks about Adam and Eva’s worlds, but not *how* she got there and how she *knows it* to be true. Where is the logic in all this she has said?

- There are people born as a result of time travel, so there is a third world.
- There are two worlds, so there is a third world.

How does she get from just one premise to the conclusions? Are the missing premises "Time travel should not exist" and “If there are two there are three”?

Neither gives us a sound argument. Just because there are two worlds does not mean there has to be a third, a fourth or a fifth. The triquetra and the picture with three worlds are cool and all, but that is meta and hints for the audience. Tannhaus’ ramblings about “duality and that nothing is complete without a third dimension”, something that Claudia parrots in the last episode, is plain nonsense. And Claudia cannot just state that "time travel should not exist" when it *in fact does*. The existence of causal loops does not point to an external, original world. We may believe that the knowledge about time travel that the original Tannhaus had passed on to Adam's world in some mysterious way and thus the book was created, but what about the rest of the causal loops? *A Journey Through Time* is just a single example and not enough to extract solid conclusions. Furthermore, the fact that she says "both worlds

are a cancer" seems to show she is just relying on wishful thinking. "I don't like what's happening, so there must be something else," is what I hear.

But then, from this already unwarranted conclusion of there being an "Origin world", she leaps to "Tannhaus was the one that created our two worlds." Where on Earth did that come from? Yes, Tannhaus ends up mingled in time travel stuff in their worlds, and his family may have founded Sic Mundus, and yes, his son, daughter-in-law and granddaughter die... But this tells us nothing. It is begging the question. As far as what we see in the series, Claudia may guess, at best, but not *know*, regardless of her intelligence. Even Einstein needed stepping stones to get to his Special Relativity.

Speaking of which, if the answer was too "scientific" for everyone to understand, at least she could have alluded to this fact and attempted to give an analogous explanation in layman's terms, just as great scientists do, such as Richard Feynman when he lectured on Quantum Mechanics. Yet she also fails to do this, and the fact that instead she gives the explanation she does seems to imply that this was never the case. "The science points to a third world, you just wouldn't understand it all", may have been a better option than what we actually received, although I cannot fathom the technology she would have needed to put that to the test.

Technically, we could imagine that the information about the third world is akin to the one contained in Tannhaus' *A Travel Through Time* and is bootstrapped. If this is the case, and this could be the case, I do not understand why they would spend precious time on an explanation that does not justify her discovery, especially when the easiest thing to do might have been for her to have opened a space-time portal through which she could see the Origin world and gather that information.

2.5.2 Could Claudia "continuously pass information to her younger self"?

Four main reasons point to a confident "no":

1) We still have to know what that information could possibly be.
2) She never mentions she has done this.
3) Claudia's path on the official Netflix site never mentions this either and is consistent with what I have explained.
4) Every younger self would have to be **another** younger self, so where are all these Claudias?

I understand that this idea may stem from the fact that she says she has used the loophole to send herself in another direction. Adding this to the list of unclear explanations, we can reasonably assume it to mean that the new direction, or path, is this alternate outcome after Adam kills alt-Martha (just as she tells Adam to send Jonas on a new path), but being Claudia the one who uses the loophole for herself, there is no other Claudia.

I have explained why this idea of Claudia passing new information to herself is not coherent with what we see during the series or with what we see Claudia do. When alt-Claudia

appears in 2020, she talks with Claudia about a “positive feedback loop”, because Eva needs Claudia to believe this and then transmit it to Jonas. Of course, Claudia then kills alt-Claudia and discovers what is going on, but even so, she keeps Jonas in the dark. “We change a grain of sand, and with that the whole world," says Jonas to Claudia in the last episode of season two, because that is what older Claudia has taught him for him to travel to 1986 as an adult, convinced that the amount of Cesium is different and that "this next time" he will change things, incapable of seeing how illogical that is. There is no “this next time”! Claudia knows that, and she meets with Adam completely aware of the fact that she will die shortly after in her personal time, although almost a century before in external time. We have no reason to believe there is any other Claudia in Adam's world, and she tells Adam that he must “send Jonas on a different path in order to *break the cycle* once and for all”. Claudia has not “broken” any “cycle”, Jonas and alt-Martha will.

2.5.3 Unrealisable desires

Finally, all this I have explained about Claudia is bad enough, but it is just part of the problem. Note that she says, “I've tried to put together the pieces of the puzzle, to understand how everything can be reborn from the same family tree *over and over again*”. She talks like this during the whole last episode. In other moments of this episode, she also says, “It goes on forever and ever,” and she tells Adam that his attempt to destroy the origin has happened “an infinite number of times”, that he and Eva create themselves “forever anew”, that they feel and cause “every bit of suffering anew”, that everything “they do *over and over again*, they do out of love”. And Eva says that “they all have to die to be reborn.”

If all I have said about time travel is true—and I certainly believe I have convincingly argued in favour of it—all these sentences do not make sense. Claudia must know they do not make sense. She knows Adam and Eva’s worlds have a beginning and she is planning their end, so she knows something cannot happen “infinite” times. As a result, it is very likely that she says that Adam has killed Martha “infinite times” and that meeting Claudia there has happened “a first time” to distinguish events that are part of a causal loop from events that are not. However, even if this were the case, I doubt every character understands this, which means that, optimistically, what others say could simply be a way of expressing one’s own perspective in a world with time travel. They all could be confused about the fact that they meet with their future versions and experience some events twice in different moments of their *personal time*, and that makes them believe those events repeat in *external time*. And it is absolutely normal for us as spectators to also be confused about this, because in the previous seasons, they had to accept their fate, and now in season three they constantly hammer in this idea of repetition. Claudia brings the solution, so it is normal for the viewer to believe what Claudia says.

The question that haunts me is *why*? Why do they say such things and why are the explanations we receive so ambiguous? Was the goal to have us here, years after the series finished, still racking our brains? Is it because of the editing they had to do to shorten the last episodes? Honestly, I would place my bets on the assumption that it was the price Jantje and Bo had to pay for the character's motivations to work. Claudia wants to end Regina's "endless suffering" and Eva wants things "to repeat again and again". As I said when

addressing causal loops, if all characters decided to quit time travelling, they would be able to carry on with their lives and would not be part of any more causal loops. Nobody is trapped in the “endless torment” that Adam is apparently trying to end. Of course, this could mean the spectator is, to put it mildly, led down dubious paths to believe that Adam and Claudia are justified in their actions.

We must realise that, if there is no “endless torment”, what they do is exterminate all life—past, present and future—from two whole universes, just to “save” four people. One could argue that they are, after all, two universes that include two apocalypses, but funnily enough, this is never mentioned as a reason for doing what they do, and nobody asks all the survivors if they would like to have their lives snuffed out. It is just blatantly false that *everybody* there suffers *all the time*. Those people are alive and, excluding what happens due to time travel, as far as we know experience suffering and joy just as we do in our own world, so arguing that Adam and Eva’s worlds *should not exist*, whatever that means, is also unjustified.

No events repeat due to time travel, but everybody seems to think so, and if confusion does not lead every viewer to believe too, we find that there are details in some scenes at the end of episode 3x07, “In Between Time”, that differ from what should be exactly the same scenes from previous episodes. If this surprise, which seems to confirm some repetition, is not on account of editing problems or reshooting and is something meaningful, I cannot understand in what way. They follow the scene in which adult Jonas departs on his journey to 2019, as we saw in season one, and should represent *exactly* what we saw in season one, but they do not. In season one, adult Jonas visits his sleeping younger self at 06:49. In these season three scenes, we see the clock reads 23:49, amongst other differences.

One may then believe that all I have said up to this point is disproven, but I have no qualms with talking about these mismatching scenes. My interpretation is based on solid foundations and I believe there is no way of coherently explaining these scenes as “repeating events that are now different”. However, barring the moment at which these scenes are placed and what that implies, we may be able to come to terms with them.

2.6 ETERNAL RECURRENCE

“Have you ever heard of the 33-year cycle? [...] Every 33 years everything is just like it was. [...] My grandpa was obsessed with such things, the Big Bang and the Big Crunch. Nietzsche’s eternal recurrence. [...] I have that same feeling again, that everything’s repeating. That this has all happened before. Like a massive déjà vu.” -Charlotte

“What if some day or night a demon were to steal after you into your loneliest loneliness and say to you: 'This life as you now live it and have lived it, you will have to live once more and innumerable times more' ... Would you not throw yourself down and gnash your teeth and curse the demon who spoke thus? Or have you once experienced a tremendous moment when you would have answered him: 'You are a god and never have I heard anything more divine.'” (Nietzsche 1882, §341)

In episode four, “Double Lives”, Charlotte talks to Ulrich about her (foster) grandfather’s obsessions and Nietzsche’s eternal recurrence, a challenge to the rightness of one’s decisions, and a concept that usually refers to an infinite loop in which exactly the same events will continue to occur in exactly the same way, over and over again, for eternity.

Obviously, this is absolutely not a *causal* loop. Charlotte was talking about a 33-year period, so we have all the reasons to believe that mentioning eternal recurrence was just an unwarranted leap regarding the kidnapping of another kid 33 years after Mads’ disappearance. Similar events are repeating, but not exactly the same ones. However, ignoring what Charlotte wanted to convey, there actually is a way (superfluous as it is) in which we can fit an eternal recurrence in *Dark*. We only have to invoke our second temporal dimension, hypertime, as an ally.

2.6.1 Resetting worlds

When detailing how the final jump to the Origin world could work, I assumed hypertime runs along ordinary time, parallel to it, until a hypertime travel to the past occurs that creates a mismatch between both times (see Figure 3, Figure 4 and Figure 9). However, when introducing hypertime, I mentioned that there is a second way of conceiving it, envisioning a whole timeline at one hypertime and a new whole timeline at the next hypertime after someone or something has time travelled. Although in this case, nothing is time travelling except, perhaps, the matter that composes the whole worlds.

- At hypertime *T1*, all times of Origin world until Tannhaus starts his machine occur. When he presses the buttons, his world is destroyed and its matter travels back in time to an unspecified moment (I will assume the year 1822) and creates Adam and Eva's worlds.
- At hypertime *T2*, all times of *a first iteration* of Adam and Eva’s worlds occur. As stated, I will assume they start in the year 1822 and I will further assume they end after September 2053, the moment in which both worlds are destroyed and their matter travels back in time again.

- At hypertime *T3*, all times of a second iteration of Adam and Eva's worlds occur (from 1822 to 2053).
- At hypertime *T4*, all times of a third iteration of Adam and Eva's worlds occur (from 1822 to 2053).
- At hypertime *T5*…

Further iterations continuously occur, in which events may be like the ones we see in the series, may be similar to the ones we see, or may be entirely different. What all these iterations will have in common is the fact that nobody will travel to the Origin world to prevent the accident. Some have imagined scenarios in which Tannhaus' original machine was built to save his family and this could be the cause of the resetting, continuously producing iterations until one arrives in which alt-Martha and Jonas will enter the tunnel of light and travel back to the Origin world's 1971 in the next hypertime. At this last hypertime, we have all times of a restored Origin world in which Tannhaus' family is saved (see Figure 12).

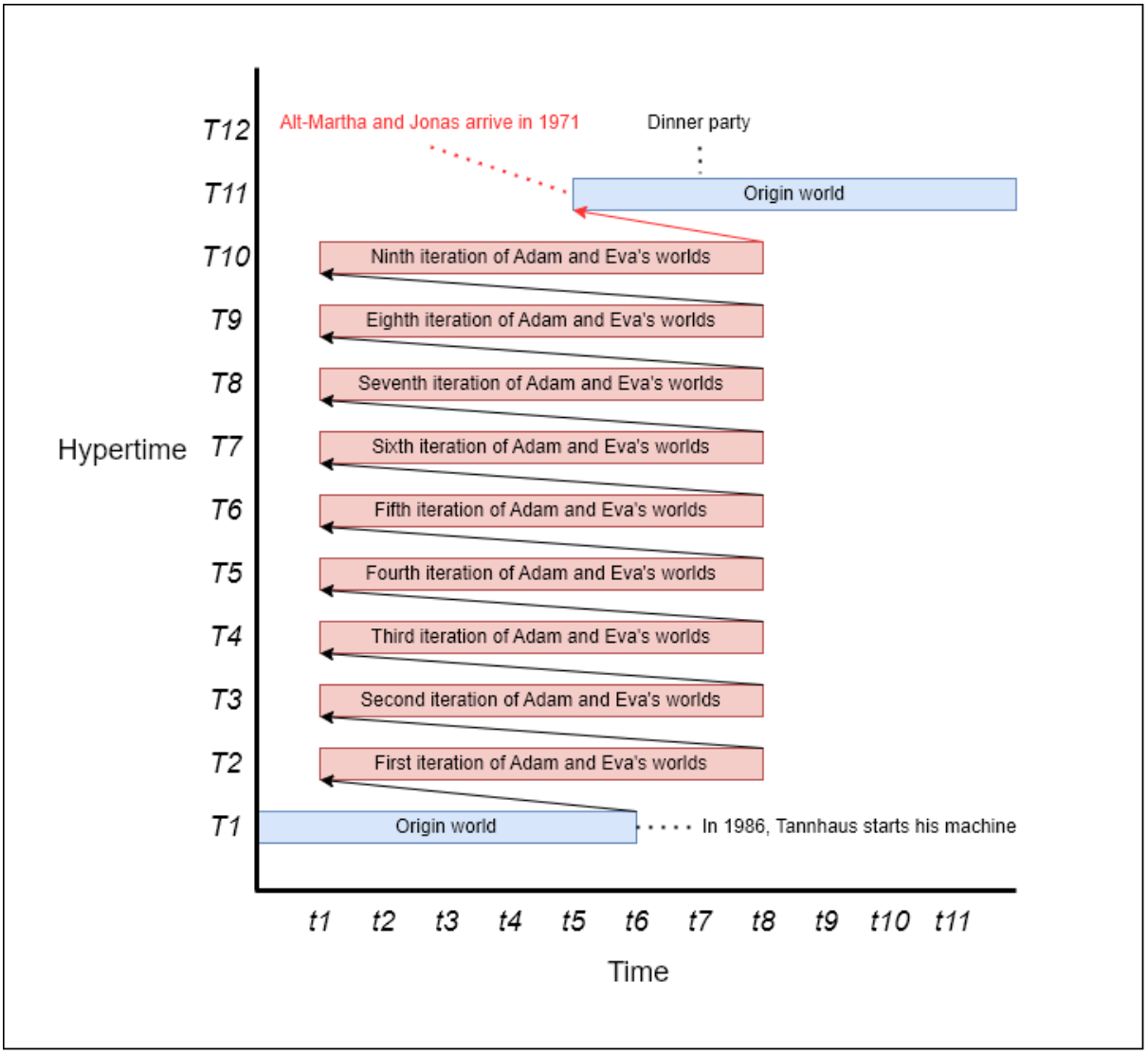


Figure 12: Eternal Recurrence (assuming for this example only nine iterations of Adam and Eva's worlds).

2.6.2 This is not going to end the way you think

Those who defend that events happen more than once because of time travel and that a "first time" is necessary for the events we see in the series—let us say *cyclers* and *causal loop deniers*—need not celebrate yet, as misconceptions about time travel are still misconceptions. This is an important observation. This hypothesis that Adam and Eva's worlds are occurring again and again is not because of the time travel obtained in them, and the established time travel rules will continue to work in every iteration. That is, even if we have been witnesses to the last (or next to last) iteration of hundreds, thousands, or millions, everything explained in this essay still applies. Every iteration will have its unique timelines (one for each world) with its unique events.

A *first iteration* is not a *first time* that causal loop deniers posit in which, for example, Elisabeth's mother is not Charlotte, or Jonas' father is not Michael. Causal loops may be obtained in iterations with Ludovician time travel, but may be different or may not even be in the previous or posterior iterations. The worlds are ending and beginning anew, which means that there is no "building up" of future events. No information can pass on from one iteration to the next. People cannot remember their lives from previous iterations. This is very relevant because we still do not know what makes the last iteration special. Claudia's knowledge about the Origin world is still not plausibly explained by this hypothesis, unless we want to suppose that she has been continuously sending her infamous diary to the next iteration, perhaps through the tunnel created by Tannhaus' original machine. Nonetheless, she could not make the next iteration Claudia aware of this, and is something never mentioned, never hinted at.

The fact is that Eternal Recurrence remains an unnecessary and *ad hoc* assumption, only to explain small details in episode 3x07. Indeed, it would in some way make true the character's belief about "eternal suffering", and would actually justify their motivations, but there is no way in which they could know that the worlds are resetting over and over anyway. For some reason, they believe this is occurring and that alone is all we have to justify their actions. However, the belief that events happen endlessly has no apparent relation to the belief in an eternal recurrence and actually seems like a genuine confusion about the implications of time travel. A confusion that is carried onto the viewer through their words and explanations.

Which is the true interpretation? I am afraid we will never receive the answer.

"Why do we die?"
"The dead are never truly dead. Maybe they are not here, now. But everything that once lived, lives on forever, in the eternity of time." -Gustav and Heinrich Tannhaus

TL;DR

1. Free will, although nonexistent, is a red herring. Even if characters had free will they would not be able to change anything.

2. “Ludovician time travel” is the best label for the common time travel we see in *Dark*, followed by “self-consistent time travel”. I would discard the “deterministic” label.

3. Jonas and alt-Martha should not disappear. The ending of *Dark* is logically incoherent.

4. A misunderstanding of the Grandfather Paradox can lead one to believe that a nonsensical sequence of events, mapped on an infinity symbol, can occur. Events in a causal loop can also be mapped on an infinity symbol, but in this case, it does make sense, although it must not be understood as if they occur more than once.

5. Based on what we see in *Dark*, Claudia’s discovery is unwarranted, and the explanations given in season three are misleading. The reason behind this may be that all characters had to be confused for their motivations to work.

6. There is a plausible hypothesis that entails an eternal recurrence by which events would happen more than once, although it is *ad hoc* and unnecessary for the series to work.

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