Article
Changing, Annulling and Otherwising the Past

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Abstract: Despite a growing number of models argument for the logical possibility of changing the past there continues to be resistance to and confusion surrounding the possibility of changing the past. In this paper I shall attempt to mitigate the resistance and alleviate at least some of the confusion by distinguishing changing the past from what Richard Hanley calls 'annulling' the past and distinguishing both from what I shall call 'otherwising' the past.

Keywords: time travel; logical possibility; changing; fixing; annulling; otherwising

1. Introduction

Almost a hundred years ago, science fiction editor, Hugo Gernsback wrote:

"The question in brief is as follows: Can a time traveler, going back in time—whether ten years or ten million years—partake in the life of that time and mingle in with its people; or must he remain suspended in his own time-dimension, a spectator who merely looks on but is powerless to do more?" [1] (p. 610)

His query was in response to several letters challenging earlier stories Gernsback had published in *Amazing Stories*. The letters insisted, that for the time travel stories to be consistent, the time travelers needed to be invisible. (See [2] (pp. 171–173) for discussion of these early 'fan' comments on time travel.)

The underlying concern perhaps, a concern made explicit in later philosophical arguments about time travel (see for example [3] (p. 177)) is that actually travelling to the past would entail changing the past and changing the past is logically impossible, so the best we can do is experience the past via early science fiction's abundant chrono-scopes, chrono-cameras, time-radios, etc. The concern isn't merely that time travelers might step off the safe path and accidentally crush the proverbial butterfly, [4] but that even building the 'safe path' in the first place would 'damage' or 'change' the time line.

Many philosophers resisted these arguments on the grounds that while changing the past is indeed logically impossible, time travel into the past does not entail changing the past—it merely entails affecting the past. [5] So given unrestricted time travel to the past you can visit the building of the pyramids or the Great Wall, you can help the Union or the Confederacy, you can peruse the library at Alexandria, you can do almost anything in the past you might want—you can even try to change the past in some way, say by trying to prevent Booth from killing Lincoln or by trying to prevent the Holocaust. If changing the past is impossible, you will fail, but if you want to try, time travel will certainly allow the trying. (See, for example, [6] for a self-defeating attempt to prevent the Holocaust.)

Even more recently however several arguments have appeared that changing the past is, contra the prevailing view, logically possible. If you want to kill Hitler before 1933 or put Aristotle on a 'better' path, you can, but you will also have to live with the consequences of your changes. (See, for example, [7] for another twist on killing (or not killing) Hitler or [8] for the potential consequences of trying to influence Aristotle.) Despite these arguments resistance and confusion surrounding the possibility of changing the past persists. In this paper I shall attempt to mitigate the resistance and alleviate at least some of the confusion. In Section 2, I first articulate a common way to model the possibility of changing the past and then in Section 2.1 present and reject Nicholas J.J. Smith's [9]

most recent arguments that these sorts of models model avoiding the past rather than changing the past. In Section 2.2, I shall consider the possibility of fixing the past and argue that we must distinguish two types of fixes—one is just a kind of change and is possible, the other is stronger, what I call, following Richard Hanley [10] 'annulling' and is not. In Section 3, I shall further clarify annulling the past by distinguishing strong annulling which is impossible from weak annulling which is a kind of change and is possible. In the process, I shall argue against Sam Baron's [11] conflation of strong annulling and change and claim that Baron ultimately concedes that the sort of changing the past that recent theorists have been interested in is possible. Finally, in Section 4, I shall argue that Peter Vranas' [12] arguments that a certain sort of change, which at first blush sounds like strong annulling, is possible in fact support the possibility of something quite distinct from strong annulment, which I shall call 'otherwising the past'. I shall conclude that despite the high potential for confusion we should be careful to separate the possibility of changing the past from the impossibility of strongly annulling the past.

2. Changing the Past

There are two general strategies in the literature for arguing that changing the past is logically possible. Firstly, one can introduce another temporal dimension or another time-like structure in addition to normal time. (See, for example, [13–18]). Alternatively one can keep just the single temporal dimension, but deny that earlier than/later than are always correlated. (See for example, [19,20], and especially [21]). I shall focus here on the first strategy, though much of what I say below can be adapted to the second.

In some works, such as [13,15], and [17], the second temporal structure is a second orthogonal time dimension. In others [14,22], what we normally think of as time is embedded in another time-like structure, not necessarily orthogonal. Either way, the second temporal structure is generally referred to as 'hypertime', and I shall continue to do so. On either treatment of hypertime, momentary time slices (or the objects or events of those slices) can be hypertemporally extended or occur again such that they have one set of properties, say grandfather being alive, at one hypertime, but grandfather being dead at another.

Let 'u' be a complete universe state at a particular time. Let 't' be times and 'H' be hypertimes. Hence, a universe without time travel could be partially represented as follows in Figure 1:

H_{1901}	...	H_{1921}	...	H_{1941}	...	H_{1961}	...	H_{1981}	...	H_{2001}	...	H_{2021}	...	H_{2041}
t_{1901}	...	t_{1921}	...	t_{1941}	...	t_{1961}	...	t_{1981}	...	t_{2001}	...	t_{2021}	...	t_{2041}
u_{1901}	...	u_{1921}	...	u_{1941}	...	u_{1961}	...	u_{1981}	...	u_{2001}	...	u_{2021}	...	u_{2041}
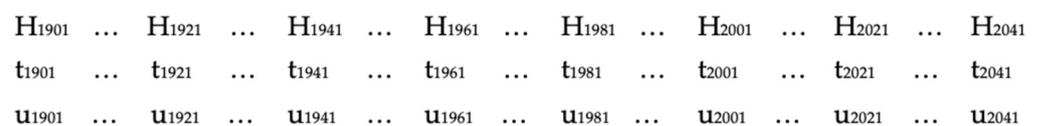
Figure 1. A hypertemporal universe with no time travel.

Given no time travel has happened, right now (t_{2021}, H_{2021}) Hitler survives past 1921—that is the way the past is right now. But suppose that the first time traveler departs for the past in 2041 (t_{2041}, H_{2041}) and arrives in 1921 (t_{1921}, H_{2042}). Why hypertime 2042? Because on almost all (see [18] for an exception) the hypertime models for changing the past, travelling backwards in time still involves moving forward in hypertime. In 1921 the time traveler kills Hitler and stays in the past to make sure no one else arises to fill the role of Hitler. We could partially represent this universe as follows (making the t's line up) in Figure 2:

In u_{1921} at t_{1921}, H_{1921} no time traveler appears and Hitler is not killed, but in $u_{1921'}$ at t_{1921}, H_{2042} a time traveler appears and Hitler is killed and so all the subsequent universe states change as a consequence.

H_{2042} ... H_{2062} ... H_{2082} ... H_{2102} ... H_{2122} ... H_{2142} ... H_{2182} ... H_{2202} ... H_{2222}

t_{1921} ... t_{1941} ... t_{1961} ... t_{1981} ... t_{2001} ... t_{2021} ... t_{2041} ... t_{2061} ... t_{2081}

$u_{1921'}$ ... $u_{1941'}$ ... $u_{1961'}$ ... $u_{1981'}$ ... $u_{2001'}$ ... $u_{2021'}$ ... $u_{2041'}$ ... $u_{2061'}$ ... $u_{2081'}$

H_{1901} ... H_{1921} ... H_{1941} ... H_{1961} ... H_{1981} ... H_{2001} ... H_{2021} ... H_{2041}

t_{1901} ... t_{1921} ... t_{1941} ... t_{1961} ... t_{1981} ... t_{2001} ... t_{2021} ... t_{2041}

u_{1901} ... u_{1921} ... u_{1941} ... u_{1961} ... u_{1981} ... u_{2001} ... u_{2021} ... u_{2041}
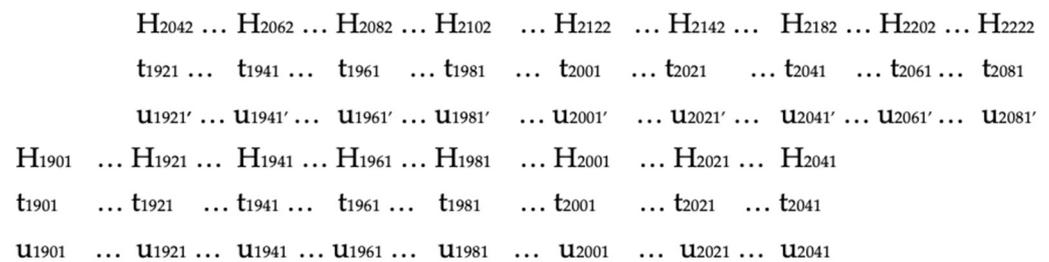
Figure 2. A hypertemporal universe with one instance of time travel.

Suppose no other time travel occurs. What is the past like in 2021 after the time travel? In 2021 (t_{2021}, H_{2142}), the past no longer contains Hitler surviving past 1921, whereas in pre-time travel 2021 (t_{2021}, H_{2021}) he does. In other words, the past used to have Hitler surviving past 1921 (at say H_{2021}), but no longer does (at H_{2042} and forward).

There is a reason I have ordered the representation via the times rather than the hypertimes. Imagine each Htu layer as a layer of paint. I start painting a surface red. I stop and then partway into the red portion start painting over the red with blue and then beyond where I stopped painting red. What does the surface look like? It has a red portion and then a blue portion (some of which overpaints an old red portion). Similarly, the covered up Htu layer is the way things used to be and any uncovered Htu layer is the way things currently are. Hence, a historian writing an accurate history in $u_{2021'}$ would describe events in u_{1901} leading to $u_{1921'}$ (along with the strange appearance of an individual in a strange machine out of thin air and the death of Hitler) leading to $u_{1941'}$ and so on up to $u_{2021'}$. A historian writing an accurate history in u_{2021} would describe events in u_{1901} leading to u_{1921} in which Hitler survives leading to u_{1941} and so on up to u_{2021}. Given that these accurate histories describe the past as it is at a given hypertime and the accurate histories are different, then the past can change. On hypertemporal models times (or the universe states of particular times) happen again at later hypertimes. Hence, t_{1921} occurs at both H_{1921} and H_{2042}. It is that occurring again that allows for change—Hitler not dying in 1921 (t_{1921}, H_{1921}) and then subsequently dying in 1921 (t_{1921}, H_{2042}).

2.1. Avoiding the Past

Despite the growing number of models purporting to model changing the past, some still argue that changing the past is impossible. According to Nicholas Smith [23]: "If there is no bifurcation, of time or place, then there can only be contradiction, not change. Yet even if there is such bifurcation, still there can be no change, only *avoidance*."(emphasis in original). More recently, Smith [9] (p. 690), in defense of his avoidance charge claims that these models are just assuming (or stipulating) that t_{1921} at H_{1921} and t_{1921} at H_{2042} "are one and the same normal time." He goes on: "But this cannot simply be stipulated. The whole point of Task Two[1] is that we need a substantive account of what makes it the case that "1928" at hypertime *b* is the same time as "1928" at hypertime a … ".

While it is not fully clear what Smith means by a 'substantive' account he does offer as examples substantive accounts of object identity through time such as endurantist accounts of objects or perdurantist accounts of objects. Interestingly enough, Meiland has been interpreted as an endurantist about the past, i.e., that the past itself is a continuant and I have been interpreted as a perdurantist about the past, i.e., that just as objects perdure by having different temporal parts, temporal moments (or the universe slice at a time) perdure by having different hypertemporal parts. (See Smith, [9]) Van Inwagen [15] can be interpreted as a hypertemporal presentist with a temporal growing block where the whole block is a continuant. Bernstein [17] considers various ontological possibilities for a moving spotlight theory. Indeed, given all these ontological options, I have been deliberately as neutral as possible concerning the underlying ontology, since regardless of the temporal ontology, the crucial piece is the ability to say that at one hypertime the events of time t

were x, but at some later hypertime the events of time t were something different than x, say y.

Admittedly, beyond asking us, say, to imagine that momentary time slices of the universe or the momentary parts of objects there-in have hypertemporal parts in the same way that extended objects can have temporal parts these authors are not fully explicit on hypertemporal identity conditions. Smith, however, seems to accept traditional accounts of object identity through time as candidate substantive accounts. Hence, isn't saying that the hypertemporal identity conditions are just the temporal identity conditions, but applied to objects through hypertime, substantive enough? Take your preferred endurantist account of how object *a* endures from t1 to t2 and apply it to universe states across hypertime. Alternatively, take your preferred perdurantist account of how object *a* perdures from t1 to t2 in virtue of having properly related temporal parts at t1 and t2 and apply it to temporal slices at hypertimes—as long as u_{1921} and $u_{1921'}$ are so related, we can say they are different hypertemporal parts of the time slice that is t_{1921}.

Given that we are concerned with logical possibility and impossibility, the defenders of hypertemporal models might claim that the burden of proof now rests on the objector—assuming that at least some endurantist or perdurantist accounts are themselves logically possible, prove that extending that account to objects enduring or perduring through a second time-like structure would generate an impossibility, otherwise the models stand. Smith, however, concludes his article with reasons to think providing a substantive account for diahyperchronic identity conditions is not possible. Given that diachronic identity conditions rely on some sort of causal dependence, and diahyperchronic identity is supposed to be just like diachronic identity, then the diahyperchronic identity conditions will too. But now Smith objects that we will run into an exclusion argument. He writes: "if we have a full story about how normal time t is (at hypertime b) in terms of how things were earlier in normal time (at hypertime b) then there is no room for a story about how things are at normal time t (at hypertime b) depending on how things are at normal time s at hypertime a." [9] (p. 692)

On the one hand, I am not sure why this is a problem. We are interested in the logical possibility of changing the past—as long as overdetermination itself is not logically impossible then, even if hypertemporal models involve causal overdetermination, these models would still provide logically possible accounts of changing the past. Indeed, given that on these models hypertemporal change only comes about because of time travel, in models such as Meiland's or van Inwagen's in which we can have hypertemporal extension without time travel we would fully expect causal overdetermination. t_1H_1 makes t_2H_1 the way it is because of the temporal causal relation between t_1 and t_2. t_1H_1 also makes t_1H_2 the way it is because of the hypertemporal causal relation between H_1 and H_2. t_2H_2 is the way it is (temporally) because of t_1H_2 and (hypertemporally) because of t_2H_1. Since there is no time travel there is no hypertemporal change and unsurprisingly then, t_2H_2 looks just like t_2H_1.

In my model, the time travel itself makes the universe slices become hypertemporally extended, so we cannot have complete causal redundancy. Consider $u_{1921'}$. It is the way it is (hypertemporally) because of u_{1921} and because of u_{2041} (because of the time travel). $u_{1941'}$ is the way it is (hypertemporally) because of u_{1941} and (temporally) because of $u_{1921'}$ (and the intervening times). Clearly u_{1941} does not suffice to account for all of $u_{1941'}$ since it is the changes in $u_{1921'}$ that accounts for the changes in $u_{1941'}$. But the worry might be that u_{1941} isn't offering any hypertemporal causal input into $u_{1941'}$ at all. To avoid Smith's charge that we are not talking about one and the same 1941, the defenders of the models have to hold that there is indeed a hypertemporal causal connection (or whatever ultimately is the required connection) between u_{1941} and $u_{1941'}$.

Again, I see no problem here. On the one hand, u_{1941} might be offering no distinct causal input other than what $u_{1921'}$ (and subsequent times) is offering. But again, as long as overdetermination is not impossible, it is not at all clear why $u_{1941'}$s contribution, whatever it is, cannot overlap completely with some part of what $u_{1921'}$ (and subsequent times) is

contributing. On the other hand, perhaps u_{1941} is offering distinct causal input. Perhaps what we normally think of as indeterministic quantum events occur the same way they do in $u_{1941'}$ not because of anything about $u_{1940'}$ but because of how those events occurred in u_{1941}. In other words, while temporal causal indeterminacies would make it impossible to predict whether a certain atom present in $u_{1940'}$ would decay in $u_{1941'}$, those same indeterminacies might not be present for hypertemporal causation. If the atom decays in u_{1941} (and is outside the cone of any changes wrought by time travel), then it will also decay in $u_{1941'}$. In this case, even if there was significant causal overlap, $u_{1940'}$ and u_{1941} would still also offer different causal contributions to $u_{1941'}$. Either way Smith's exclusion argument fails.

Smith, however, also offers a slightly different exclusion argument. He writes:

"Meiland and Goddu want a model in which effects propogate through normal time in the usual way and objects persist through normal time in the usual way. But this is incompatible with the kinds of view one would need to have about causal dependency to think that the same time can persist across hypertime. The former requires thinking: how t_1 is at hypertime *b* depends on how earlier normal times are at hypertime *b* and how earlier normal times are at hypertime *b* suffices for how t_1 is at hypertime *b*. The latter requires thinking: how t_1 is at hypertime *b* depends on how t_1 is at hypertime *a* and how t_1 is at hypertime *a* suffices for how t_1 is at hypertime *b*. These claims of causal dependence and sufficiency cannot all be true." [9] (p. 692)

I agree that both dependency/sufficiency claims cannot be true at the same time, as long as we read 'depends' as 'depends only', or else we are right back into the possibility of overdetermination. But since the first claim is incompatible with time travel itself and Smith accepts the logical possibility of time travel, we should just reject the first dependency/sufficiency claim. For example, even without a second temporal dimension, with time travel into the past it is just not true that how t_1 is depends on how earlier normal times and how earlier normal times are suffice for how t_1 is. After all, how t_1 is might depend on how later normal times are. Similarly, in hypertemporal models, how t_{1921} at H_{2042} is depends on how t_{1921} at H_{1921} is and how t_{2041} at H_{2041} is and yet t_{2041} is later in normal time.

In addition, I strongly suspect that many hypertemporal theorists will reject the second claim as stated and still hold that one and the same time can be extended across or endure through hypertime. In the example previously given in which u_{1941} and $u_{1940'}$ offer partially overlapping causal inputs to $u_{1941'}$ it is true that $u_{1941'}$ depends on both, but neither alone suffices. But then how t_{1941} is at H_{1941} is not sufficient for how t_{1941} is at H_{2062}, but how it is at H_{2062} still depends on how it is at H_{1941}. Why, then, is t_{1941} the same time at both H_{2062} and H_{1941}? Because there are no other hypertemporal causal relations between any other hypertimes and t_{1941}.

I grant that further work may need to be done to articulate the details on how objects are related through hypertime. It may turn out that some articulations are more palatable than others. For example, it may be easier to grasp how the temporal growing block endures through hypertime and gets truncated or expanded more rapidly via time travel than it is to see how pushing the button on the time machine at t_{2041}, H_{2041} causes t_{1921} (which last existed at H_{1921}) to become hypertemporally extended and exist again at H_{2042}. In other words, my model looks to have causation across both time and hypertime gaps.[2] Regardless of palatability, the issue for any such hypertemporal model is whether it is logically possible and models changing the past. Smith's arguments do not challenge the claim that they do.

2.2. Fixing the Past

Once we allow the possibility of changing the past does anything go? No, since we still cannot make, say, $u_{1981'}$ itself be contradictory. The best we can do is make 1981 one way at one hypertime and another way at another hypertime. But what about the

following popular time travel plot lines. Despite how careful the time travelers were, they did something that changed the past such that when they arrive back in the future things are drastically (and problematically) different. So back they go to fix their mistake. Or the time travelers deliberately set out to change the past—say kill Hitler as an infant to prevent the Holocaust, but when they arrive back in the future, they find an even worse history awaiting them. Oops! Back they go again. Or the bad guys temporarily get the upper hand by changing some key event in the past, so the good guys set out to fix it. The common want in all of these scenarios is the desire to undo the initial change and to fix the past. Is it possible to fix the past?

In [14], I implied a 'no' answer. But now I want to be more careful. The answer depends on what counts as an acceptable fix. For example, if the paint on my house is old and peeling, I might scrape the peeling paint down to the siding and try out a new color paint. My wife looks at the new color on the house and decides it is not nearly as good at it looked on the little color cards. She says she wants the old color back. My solution—put on a new coat of paint in the original color. Similarly, I can fix the dishwasher by taking out the defective part and putting in a working replacement part.

Time travelers, in hypertemporal models, can accomplish these sorts of fixes on the past as well. I can go back and kill grandfather before my mother was born, jump back to the present and find things horribly wrong. Back I go and intercept myself before the fatal shooting of grandfather. Have I made things *exactly* like they were before any time travel occurred? No. The first version of events contained no time traveler arriving to kill grandfather, but the successful fix contains two time-travelers—one potential killer and one preventer. But I haven't made my house exactly like it was before either, even if the new paint is the same color as the old paint—it is still new paint.

But could I get things back *exactly* the way things were before? There are two things one might mean by "exactly the same as before"—one could mean that the events of the most current hypertemporal chain of events are in one-to-one correspondence with the events of the original chain. On the other, one could mean that the universe just reverts to containing merely the original chain of events.

The first I suspect is logically possible—it is still a kind of change, but it might take God to help pull it off rather than just the efforts of any time traveler. The second, however, appears to be stronger than change. The time traveler does not want to change the first change—the time traveler wants the first change not to have happened at all–they want to not just change the past—they want to annul it. Can we give time travelers that?

3. Annulling the Past

To change the past is make the past different than it once was. For example, on hypertemporal models the time traveler might succeed in changing the past so that the past no longer includes the Holocaust. The time traveler might be motivated by the desire that her mother not have suffered so much during those years. But on a little reflection, our potential time traveler might conclude that changing the past is not enough. She does not merely want to change the past so that (hypertemporally) now her mother did not suffer then—she wants to make it such that no part of the past *ever* contains her mother suffering for that is what the time traveler wants to eliminate from the universe—the suffering.

To annul an event of the past is to make that event never have been a part of the past. Hanley [10], (p. 337) claims most time travel stories depict annulling the past, and also claims that annulling the past is impossible. Of course, he defines annulling the past as "making it the case that (unrestrictedly) some event both occurred and never occurred." But I take it our hypothetical Holocaust annuller does not, at least explicitly, have that contradictory want—she do not explicitly want the suffering to have both occurred and not occurred—she merely wants it to have never occurred.

Is annulling the past possible? Is it the case that we can make the past never contain the Holocaust? It depends on what we mean by 'never'. We could mean 'never' in the sense that the Holocaust is completely removed from the universe. If the Holocaust annuller is

interesting is eliminating the suffering, she can certainly want to have it just not be a part of the universe at all. Define strong annulment then as follows:

> *Strongly annulling the past:* To strongly annul the past is to make some event of the past never be part of the universe in its entire spatio-temporal expanse.

The universe is everything, not just everything now. Even if one is a presentist one can talk about the universe in its entire spatio-temporal expanse—it is just everything that was, is, and will be. Hypertimes are a type of time and so will be part of the temporal expanse of the universe. The universe is every single u at every single H at every single t regardless of which parts are 'real' or 'exist' or are 'accessible' at particular times or hypertimes. Strongly annulling the past then is to make some part of the universe in its entire spatio-temporal expanse not be part of the universe in its entire spatio-temporal expanse. As Hanley would put it, to make something that is unrestrictedly part of the universe, unrestrictedly not part of the universe.

Strongly annulling the past is logically impossible, since nothing can be unrestrictedly part of the universe and also unrestrictedly not part of the universe. We certainly cannot strongly annul the past on hypertemporal models. On such models the past becomes hypertemporally extended, but we do not remove or eliminate any of the hypertemporally past versions of the past. Think again of the model in terms of layers of paint. The original version of the past is the bottom layer of paint. Time travel to the past starts a new layer of paint over some portion of the bottom layer.[3] Traveling back again is just putting yet another layer over some portion of the previous layer. Hence, we can ask coherently whether a third Htu layer is in one-to-one correspondence event-wise with the bottom layer (at least the parts that overlap), but we cannot make the second Htu layer not be part of the universe.

Though there may be some debate about whether most time travel stories involve changing the past or as Hanley claims what I am calling strongly annulling the past, we should not conflate the two. Changing the past involves the past being one way and then another, annulling the past involves the past being one way and (unrestrictedly) never that way. The former is logically possible, while the latter is not. Yet, Sam Baron in "Back to the Unchanging Past" seems to make exactly this conflation. He writes: "A time traveler, Tim, **changes** the past when he brings it about that some event, object or property which is part of the past when he begins his journey through time is no longer a part of the past at the end of the his journey through time." [11] (p. 130, emphasis in original) So far so good. But he immediately continues:

> "Changing the past, as I will understand it, means 'overwriting' the past. A time traveler overwrites the past when they bring it about that an event E that (unrestrictedly) occurred before their journey through time (unrestrictedly) never occurred by the end of their journey through time."

In a footnote to the just quoted text, Baron writes: "I believe that changing the past in my sense is what Hanley (2009, p. 337) calls *annulling* the past … " Certainly, if we understand Baron's 'unrestrictedly' as 'part of the universe in its entire spatio-temporal expanse', then 'overwriting' and 'strongly annulling', and Hanley's 'annulling' are effectively the same.

But despite his claim that by 'change' he means 'overwriting', the definition he gives of 'change' is not the same as the definition he gives of 'overwriting'—to say that something is *no longer* one way is certainly different than saying it was *never* that way. It is true that the Blackburn Rovers are *no longer* a contender for winning the English Premier League (after all they play in the Championship League now), but it is false that they *never* were a contender for winning the English Premier League (since they won it during the 94/95 season). Hanley certainly does not conflate changing the past and annulling the past—for Hanley they are two separate categories. He thinks changing the past is possible. He also thinks that annulling the past more accurately captures what is going on in most time travel

stories. I disagree, but regardless, we both accept that changing the past and annulling the past are different things.

Indeed, if all Baron means by 'changing the past' is 'strongly annulling the past', then I agree with Baron that such 'change' is logically impossible and I certainly did not need any of Baron's arguments to convince me that that is impossible. I can think of no philosopher who presents a model purporting to model changing the past who was trying to model strong annulment.

There is, however, a weaker sense of annulment that is available as follows:

Weakly annulling the past: To weakly annul the past is to make some event of the past never be part of the past.

Hypertemporal models can make a reading of that sentence come out true (but notice that the 'unrestricted' is gone and the 'never' will need to be read in a particular way.) Right now (t_{2021}) it is part of the past that Claus von Stuaffenburg is executed by the Nazis. Suppose instead of killing Hitler our time traveler rescues von Stauffenburg just prior to his execution and ferrets him to safety. After the time travel occurs and assuming no further time travel, in t_{2021} it is never (temporally) the case that Claus von Stuaffenburg is executed by the Nazis. After the time travel and successful rescue occurs there is no accessible momentary temporal slice that contains such an execution. On hypertemporal models what counts as the past (at a particular hypertime) are just those temporal slices that are both prior to the (hypertemporally) current temporal slice and accessible from the current slice. In other words, at a given hypertime, the past is whatever universe states are in the topmost Htu layer prior to that hypertime. So, referring back to Figure 2, at H_{2021}, the past includes u_{1901}- u_{2020}, but at H_{2142}, the past includes u_{1901}-u_{1920} and then $u_{1921'}$-$u_{2020'}$. As long as von Stauffenburg is never executed by the Nazis within the string of universe states accessible at H_{2142}, then it is true that the time traveller has made the (hypertemporally current) past such that von Stauffenberg is never executed in it. Hypertemporally of course it once (say t_{2021}, H_{2021}) was the case that von Stuaffenburg was executed by the Nazis, but now (say t_{2021}, H_{2142}) he no longer was executed by the Nazis. In other words, weak annulment is possible if 'never' is read temporally, but not if 'never' is read hypertemporally.

Baron's two definitions of 'change' and 'overwriting' might come out equivalent on hypertemporal models if we read them as follows: A time traveler changes the past if he or she makes it the case that some event that was (hypertemporally) part of the past is no longer (hypertemporally) part of the past. A time traveler overwrites the past if he or she makes it the case that some event that was (hypertemporally) part of the past now (hypertemporally) never (temporally) was part of the past.[4] But this weaker kind of annulment is just a kind of change and is certainly not capturing what Hanley intended by annulment. Recall we want to remove the suffering not just from the way the past is now, but from the universe entirely.

In response to a potential objection to one of his arguments against the possibility of strongly annulling the past, Baron writes:

"At one hypertime, the past is one way—it features a war, say—and at a distinct hypertime, the past is a different way—it features no war. Add a time traveler who is responsible for this qualitative variation, and surely we can say that they've changed the past."

"Again, I am willing to admit that this is 'change' in some sense. But it is not the notion of changing the past outlined in Section 2 [his definition of overwriting]. At best it is a version of the regular notion of change found in one-dimensional models of time." [11] (p. 141)

So far there is no problem, since that is exactly what changing the past advocates are trying to present—an account of the regular notion of change that successfully applies to the past. After all, we want to make sure we are still talking about change and not something else entirely. But after laying out the regular notion of change and showing

how it applies with hypertimes, Baron writes: "But all we have done is take the ordinary, unobjectionable kind of change—change that we always knew Tim could get up to in the past—and smear it out over a second, . . . dimension." [11] (p. 141)

Now we need to be extremely careful about what we are asking of Tim. Those who grant that time travel into the past is logically possible grant that Tim can affect the past, i.e., Tim can go into the past and interact with things. Tim can, for example, go back into the past and paint houses, turning a white house into a blue house. Tim can be the agent who changes a house in the past from being white to being blue. This is no different than what Tim can do in the present with no time travel at all. But we want Tim to be able to change the past—to go back in time to a house that was white throughout 1970 and paint it in June 1970 so that it is blue throughout the last half of 1970—that is what it would be to change the past and not merely affect it. And hypertemporal models provide a way to do exactly that—at one hypertime the past is such that the house is white all through 1970, but at a later hypertime, after the time travel, the house is white for the first half of 1970 but blue for the last half. Indeed, this is what I would describe as overwriting or undoing the past—the past was once one way and now we have overwritten it (or undone it) and made it another way. What we have not done (and cannot do) is make it such that the house was white throughout 1970 and now make it such that no part of the universe in any of its temporal, hypertemporal, or whatever extent is such that the house is white throughout 1970.

Strong annulment, with no restriction on 'never' is impossible—what was once part of the past cannot now never be part of the universe at all. Weak annulment is just a type of change and is possible according to the extant models of changing the past. We should not conflate the two.

4. Otherwising the Past

Strong annulment of the past is logically impossible. But then what are we to make of Peter Vranas' arguments about replacing the past? He writes:

> "Do I really want it to be the case that there is a first 1987 in which the declaration of love occurs and a second 1987 in which the declaration does not occur. No, I rather want it to be the case that the declaration never happened; I want it to be the case that there is a single 1987 in which, as a result of something I do in 2005, the declaration does not occur. To use a label, I want to replace the actual past." [12] (p. 371)

Terminology aside, what Vranas calls replacing the past certainly sounds like what I have been calling annulling the past. Vranas goes on to argue that (1) replacing is a kind of change and (2) that in fact it is the more interesting kind of change than the transforming kind of change I talked about in the previous section. Finally, he also argues that (3) if affecting the past is possible, then so is replacing the past. But since affecting the past seems to be the least problematic of all time traveler abilities, if Vranas is right, and if replacing the past is annulling the past, then it is also possible to annul the past!

I am not concerned with (1) since whether replacing is a kind of change is ultimately a terminological dispute about how to use the word 'change' and, with regards to actual usage, Vranas is right that we use 'change' in both the transformative and replacement senses. We can change light bulbs either by painting them or by unscrewing them and screwing in a new light bulb. Quibbling about what is 'really' change here is fruitless.

The only support that Vranas provides for (2) is an analogy with the future. He argues that talk of "changing the future is more interestingly understood as replacing than as transforming it. . . . Do I want to transform the future? No. I realize that such a desire would be incoherent (i.e., it could not possibly be satisfied.) I want instead to replace the future, to bring about a non-actual future, a future in which I don't die under torture." Similarly for the past: "Changing the past is more interestingly understood as replacing than as transforming it. I don't want to transform the past: I realize such a desire would be

incoherent. I want instead to bring about a non-actual past, a past in which I am born by Caesarean section." [12] (p. 374)

One might doubt that we really want to replace the future, but even if we do, does the analogy hold? One might say that it makes sense to desire replacing the future because the future is open, but does not make sense in the case of the past because the past is closed. What time travel allows, one might argue, is that I can hope to get to that past and make it other than it was before I pushed the button on my time machine—i.e., I can hope to transform it.[5]

Even if one insists that the analogy holds, I suspect there is a deeper problem with (2). To see the problem we need to examine Vranas' argument for (3)—If we can affect the past, we can replace it. Vranas argues for (3) from the single premise that "if it is possible to have a given causal effect on the past, then it is also possible to have a different, incompatible causal effect on the past." [12], (p. 377) Given that the effects are incompatible, they do not happen in the same possible world, and so it will be true that there is a possible world in which, as a result of my time travel, that world's past is different than the past of the actual world. For example, is it possible for me to kill Hitler before he becomes the leader of the National Socialist Party? Yes, even ignoring hypertimes, since there is a possible world in which I travel back in time and kill Hitler. Of course, that world is not the actual world, but rather a world in which Hitler never became the leader of the National Socialist Party. It is also quite likely a world in which I go back and kill Hitler for some reason other than his becoming the leader of the National Socialist Party and engendering the Holocaust, because those things do not happen in that world either.[6]

Surely that is too easy—is that really all it takes for it to be possible that I travel back in time and kill Hitler and prevent the Holocaust? Well, in a sense yes, but is it the sense Vranas said he was going to provide? No.

I grant that I have the ability to do something, kill Hitler before 1940 say, such that were I to do it, the past would have been different than it actually is. Call this ability, the ability to otherwise the past. (A similar ability holds for the future.) Whether I can otherwise some event of the past depends on whether there is some possible world in which, as a result of something I do in that possible world, the past there is other than it is in the actual world.

Is otherwising the past the same as, Vranas' terminology choice aside, replacing the past? No. To replace a light bulb is to remove the old bulb and put another one in its place. To replace a government is, in one form at least, to remove the elected officials from office and put other officials in their place. If we are really talking about replacement, which is a kind of change, then to replace the past, or a part of the past, is to remove that part and insert a different part. But that is certainly not what happens in the world in which I kill Hitler. I do not remove some part of the past and insert a new version.[7] I kill Hitler and there is no Holocaust—but there never was a Holocaust in that universe. (Maybe for good measure I get Stalin in that universe too.)

I grant that if I can affect the past, then I can otherwise the past. But otherwising the past is not replacing the past. Nor is otherwising the past annulling it, since I do not make some event that was part of the past (in the actual world) not be a part of the (actual) universe at all. If we consider the other possible world in which I do kill Hitler, I do not make some event that was part of the past in that world to not be part of the past in that world—I just make the past of that world as it always was. But then Vranas has not shown that what we would normally think of as replacing the past, and so annulling the past, is possible.

Is otherwising the past even interesting? Is it really, as Vranas suggests, under the guise of 'replacement' at least, what time travelers want? No. Imagine that you want to remove all the suffering of your mother during the Holocaust. Lucky you, I happen to have here a time machine that allows unrestricted (temporal) time travel. Even better, I tell you that you have the ability to otherwise the past (though to make the ability more palatable I may talk about being able to replace the past). You have the ability to do something, such

that if you were to do it, the past would be other than it actually is. You doubt that you have such an ability, so to reassure you, I provide Vranas' arguments and examples. You admit you have that ability[8], but are crestfallen. Why? Because you realize that, even with the time machine, and the ability to otherwise the past, you cannot make *this* universe such that your mother's suffering is not a part of it.

5. Conclusions

Sixty years ago, the philosophical consensus was that time travel to the past was logically impossible. Carefully distinguishing changing the past from affecting the past, however, shifted the consensus toward the logical possibility of time travel to the past. Even more recently some philosophers have argued that changing the past is logically possible. Whether that becomes the new consensus position on time travel remains to be seen, but at the very least it, if what I have argued here is correct, then there are models that model changing the past without being avoidances of the past. At the same time there are still limits on what is possible, even if we can, via time travel, at least in certain sorts of universes, change the past. We cannot, as Hanley notes some time travelers might genuinely want, strongly annul the past or fix the past by strongly annulling some unfortunate change already made.

Even Vranas' 'replacing the past' which I have labelled 'otherwising the past' does not provided us a way to give Hanley's most demanding time travelers what they want, for otherwising is not the sort of change we typically call replacing nor is it strong annulment. In fact, I see no way to give these time travelers what they want—to make it such that some part of the past is no longer part of the universe, in all its spatial, temporal, hypertemporal, or whatever extent, at all. To be subject to strong annulment, the part of the past must be a part of the universe. Being part of the universe in all its extent, it cannot also not be a part of the universe. Strongly annulling the past is logically impossible. To make one's greatest foe or the Holocaust to have never been a part of the universe is impossible. Even with time travel, we are too late.

Conflicts of Interest: The author declares no conflict of interest.

Notes

1.   Task Two: "we need to give substantive content to the claim that some normal time t1 at hypertime a and some normal time t2 at hypertime b are or are not (hypertemporal parts of) the same normal time." [9] (p. 684).

2.   Though once you are fine with causation across temporal gaps because of time travel itself, I am not at all sure what the extra burden is for causation across a hypertemporal gap.

3.   In [14] changes made in the past propogate everywhere hypertemporally instanteously. Hence, time travel to the past terminates the lower layer. But if you change the rate of propogation you can get models that allow different things. For example, if the changes propogate forward one temporal instant per hypertemporal instant, then the original timeline would keep progressing forward. In effect you would have a growing universe with two moving presents. The bottom layer would be progressing forward at one time per hypertime, and a hundred years back on the timeline, the second layer would also be progressing forward at one time unit per hypertime overwriting the bottom layer as it progressed.

4.   For the two definitions to be equivalent we might also need a pretty stringent view of event individuation. Even if the time traveller ferrets von Stauffenburg to safety, if ex-Nazis hunt him down and execute him in 1950 say, we might not be able to say that the execution of von Stauffenburg by the Nazis is never part of the new past. But this ultimately hinges on how we are individuating events. The execution as it occurred originally has been eliminated from the timeline, but is the new execution a new version of *that* event or a completely different event? However this issue is ultimately resolved, 'overwriting' would at worst still be a subclass of 'change'.

5.   On hypertemporal models it actually does make sense to desire a transformation of both the past and the future.

6.   I do not say impossible, since God could give me, in the dead Hitler world, a vision of how things are in our world, such that that vision motivates me to go back in time and kill Hitler.

7.   Just as there is a weak sense of annulling that comes out true on hypertemporal models there is a sense of replacement that is possible on hypertemporal models. From the hypertermporal perspective it looks like we transform the past—we make u_{1941} into $u_{1941'}$. But temporally you might say that u_{1941} gets replaced by $u_{1941'}$.

8   I also grant that another consequence of Vranas' arguments might be that one doubts the efficacy of possible world models of 'ability' or that it is capturing the time traveller's relevant abilitities. I take no stand on that possibility.

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