

DO CRY OVER SPILT MILK: POSSIBLY YOU CAN CHANGE THE PAST

There is widespread agreement, even among those who accept the possibility of backward causation, that it is impossible to change the past. I argue that this agreement corresponds to a relatively uninteresting understanding of what changing the past amounts to. In one sense it is indeed impossible to change the past: in no possible world is an action performed which makes the past in that world different from the past in that world. In another sense, however, it may be possible to change the past: maybe in some possible world an action is performed which makes the past in that world different from the *actual* past. I argue that those who accept the possibility of backward causation are committed to accepting the possibility that the past changes in the latter sense.

1. Introduction

On the 24th of July 1987 I did something I had never done before: I revealed to a woman that I was in love with her. I wish I had not done so: the timing was bad. I was about to go abroad for a number of years, and I suspect that the woman's knowledge of this fact weighed heavily in her refusal to form a relationship with me. I wish I had spoken only after coming back from abroad. But it's no use crying over spilt milk—or is it?

Can I *now*, in 2005, make it the case that I had not spoken to that woman in 1987? The suggestion sounds absurd. It is widely agreed that it is logically impossible to change the past. Even love is bound by the laws of logic. But what if time travel to the past were possible, as some physicists think it may well be?¹ Then, according to many philosophers, it would be possible to *affect* the past—to have a causal effect on it—but it would still be impossible to *change* the past.² To appreciate the distinction between affecting and changing the past, suppose the following scenario is possible. In 2005, being 40 years old, I enter a time machine. After two minutes, as measured by my watch, I exit the machine on the 24th of July 1987, still being 40 years old. Then I go to a payphone, I call my 22-year-old younger self, and I try to talk him out of speaking to the woman. It turns out, however, that he had not even considered doing so; perversely, it is my very phone call which makes him decide to speak. In

this scenario I have a causal effect on the past: in 2005 I initiate a causal sequence which results in the occurrence of a declaration of love in 1987. So I *affect* the past. Still, I don't *change* or *transform* the past: in the scenario it is not the case that there is a *first* 1987 without the phone call and a *second* 1987 with the phone call. There is rather a *single* 1987, which includes the phone call. It seems then that even time travel would not give me what I want, namely an ability to transform the past.

But is this *really* what I want? 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: I want to bring about a nonactual past. If so, then what I want may be possible after all: if the scenario in the last paragraph (in which the phone call does not prevent but rather causes the declaration of love) is possible, then the alternative scenario is also possible in which the phone call does prevent the declaration of love. Granted, this alternative scenario is not *actual*, since in the actual world the declaration did occur in 1987. But the question is whether I can *bring about* this alternative scenario, whether I can replace the actual past. And my point is that *if* I can bring about the original scenario *then* I can also bring about the alternative scenario: I can now enter a time machine, exit in 1987, and make a phone call which prevents my younger self from speaking to the woman. Admittedly I *will not* do so, but it does not follow that I *cannot*.

Let me recapitulate what I did in the last two paragraphs. First, I went over a well-known distinction between *affecting* and *changing* (in the sense of transforming) the past. Second, I introduced a—to my knowledge novel (though cf. Mavrodes 1984: 143f)—distinction between two senses of 'changing the past': *transforming* and *replacing* the past. Third, I suggested that changing the past is more interestingly understood as replacing than as transforming the past; this is my first main thesis in the present paper. Fourth, I suggested that *if* affecting the past is possible (alternatively: feasible) *then* so is replacing the past; this is my second main thesis in the paper. I did not defend the possibility of affecting the past: this would be a large project, because it would require defending the possibility of backward causation. But many philosophers already accept that affecting the past is possible; if my two main theses are correct, then these philosophers should further accept that changing the past in the more interesting sense—namely replacing it—is also possible.

In Section 2 I elaborate on the distinctions between affecting and changing and between transforming and replacing the past. In Section 3 I defend my first main thesis, namely that changing the past is more interestingly understood as

replacing than as transforming the past. In Section 4 I defend my second main thesis, namely that if affecting the past is possible (alternatively: feasible) then so is replacing the past. I conclude in Section 5.

2. *Affecting, Transforming, and Replacing the Past*

I *affect* the past exactly if I have a causal effect on the past; in other words, exactly if the past is what it is partly as a result of an action that I perform now.³ If, for example, I push now (in 2005) a button in my time machine and the machine shows up in 1987 as a result, then I affect the past. Or if, to use an example without time travel, an avalanche occurs in 1987 because I shout in 2005, then again I affect the past. Clearly, I affect the past only if backward causation occurs. But I am not presupposing that affecting the past is possible, so I need not (and I will not) address the arguments of those who contest the possibility of backward causation.⁴ What matters for my purposes is that when I affect the past I don't change it. It's true that in some cases in which I affect the past I cause the occurrence of a change in the past; for example, the avalanche in 1987 flattens a building.⁵ But to cause the occurrence of a change in the past is not to change the past.

What is it, then, to change the past? I *change* the past exactly if I perform now an action which makes the past (qualitatively) different from what it is.⁶ I have no example of a case in which I change the past because no such case exists: no matter what action I perform now, the past is what it is and is not different from what it is. One might object that in some cases I do make something different from what it is; for example, when I get married, I perform an action which makes my marital status different from what it is. In reply note that, when I get married, I perform an action which makes my marital status *after* the action different from what it is *before* the action. But no matter what action I perform at a time *t*, the past of *t* 'after' the action is the *same* as the past of *t* 'before' the action (assuming that talk of the past of *t* 'before' and 'after' an action makes sense at all).⁷ I conclude that there is no case in which I change the past.

This is not the end of the matter, however. Whether I *in fact* change the past is one question, whether it is (logically, timelessly) *possible* that I change the past is quite another (and whether I *can* change the past is still another). It is possible that I change the past exactly if there is a possible world in which I⁸ perform an action which makes the past different from what it is. But different from what it is in *that* world, or different from what it is in the *actual* world? (I use 'actual world', 'actual past', etc. *rigidly* throughout the paper.) Depending on how we answer, we get two ways to understand the statement that it is possible that I change the past:

- (P1) There is a possible world w in which, at some time t , I perform an action which makes the past of t in w different from what the past of t in w is.
- (P2) There is a possible world w in which, at some time t , I perform an action which makes the past of t in w different from what the past of t in α is.⁹ [α is a name of the actual world.]¹⁰

It might seem unnatural to understand the statement that I possibly change the past as P2: P2 mixes a nonrigid and a rigid use of 'the past'. Such mixing, however, is in fact natural. We say, for example, that the past could have been different from what it is. (Indeed, the past *would* have been different if I had not spoken to the woman.) This amounts to saying that there is a possible world in which the past is different from the actual past. On the other hand, it seems that those who deny the possibility of changing the past shift to using 'the past' only nonrigidly: maybe they are rejecting P1.¹¹

P1 is by definition the claim that I possibly *transform* the past, and P2 is by definition the claim that I possibly *replace* the past. I *in fact* transform the past exactly if I in fact replace it; equivalently, exactly if I in fact change it, namely never. But although transforming and replacing the past are thus (trivially) coextensive, they need not be cointensive. It is not possible that I transform the past: no matter what action I perform at t in w , the past of t in w ('after' the action) is the *same* as the past of t in w ('before' the action). It may be possible, on the other hand, that I replace the past. Suppose, for example, it is possible that I push now a button in my time machine and thus send the machine to 1987, but in fact I don't push the button and the machine does not show up in 1987. Then there is a possible world w in which I perform an action in 2005 (I push the button) which makes the machine show up in 1987 and thus makes the past of 2005 in w different from the actual past of 2005.¹² I conclude that replacing the past may differ from transforming it. But does replacing the past really count as changing it? And *can* I replace the past? In the next two sections I address respectively these two questions (among others).

3. Replacing the Past Counts As Changing It

To see that replacing the past really counts as changing it, consider an analogy with the future. Suppose I will in fact die under torture in 2025.¹³ If nevertheless I were to commit suicide tomorrow, then I would prevent this horrible death. It is natural to say that I would then change the future, since I would change the time and manner of my death. I would change the future in a sense which corresponds to replacing: I would bring about a nonactual future, a future in which I don't die under torture, contrary to what happens in the actual future. It's true that in another sense, which corresponds to transforming, I would not

change the future: I would not make the actual future different from the actual future. But even if this shows that transforming is a legitimate sense of 'changing the future', no problem arises for my claim that replacing is (also) a legitimate sense.

I also wish to make a second claim, however. In addition to claiming that (1) changing the future is *legitimately* understood as replacing it, I wish to claim that (2) changing the future is *more interestingly* understood as replacing than as transforming it. My point is that, when people want to change the future, they normally want to replace it, not to transform it (or at least this is what they would want if they were not confused). To see this, consider the question of what exactly I want when I want to prevent my death under torture although I am certain that this death will occur.¹⁴ 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).¹⁵ I want instead to replace the future, to bring about a nonactual future, a future in which I don't die under torture. My desire is not incoherent: it *could* be satisfied. Admittedly I am by assumption certain that my desire *will not* be satisfied, but it need not be incoherent to desire something you are certain you will not get.

Two parallel claims hold, I submit, with respect to the past. (1) Changing the past is *legitimately* understood as replacing it. If I were to visit 1965 by time machine and induce my mother's obstetrician to perform a successful Caesarean section on my mother, it is natural to say I would change the past: I would change the (time and) manner of my birth. I would change the past in the sense of replacing it: I would bring about a nonactual past, a past in which I am born by Caesarean section, contrary to what happens in the actual past. (2) Changing the past is *more interestingly* understood as replacing than as transforming it. I don't want to transform the past: I realize that such a desire would be incoherent. I want instead to bring about a nonactual past, a past in which I am born by Caesarean section. My certainty that this desire will not be satisfied does not make the desire incoherent. Whether the desire is incoherent for some other reason remains to be seen (cf. Section 4); my point for the moment is that I desire to replace the past, not to transform it.

One might object to my claim that changing the past is legitimately understood as replacing it by arguing that, according to standard theories of change, replacing the past does not count as changing it. To explain how the objection works, I will first give some background on standard theories of change. (As an interesting aside, I will also examine what such theories imply about the possibility of changing the past.) Take first a 'four-dimensionalist' theory of change, for example David Lewis's:

Change is qualitative difference between different stages—different temporal parts—of some [perduring¹⁶] thing, just as a "change" in scenery from east to west is a qualitative difference between the eastern and western spatial parts of

the landscape. ... [T]hen what doesn't have temporal parts can't change. ... [T]he events of a past moment are not subdivisible into temporal parts and therefore cannot change. ... Not that past moments are special; no more can anyone change the present or the future. Present and future momentary events no more have temporal parts than past ones do. (Lewis 1976: 145f, 150.)¹⁷

Even if one grants Lewis that, because 'what doesn't have temporal parts can't change', *the events of a past moment* cannot change,¹⁸ it does not follow that *the past* cannot change: the past, understood as containing the events of all past moments, has plenty of temporal parts.¹⁹ In response one might argue that the past is not a perduring thing, as people, nations, and galaxies are; the past is rather a process, as wars, speeches, and races are. But why can't processes change?

An answer is proposed by some 'three-dimensionalist' theories of change, for example D. H. Mellor's. According to Mellor (1998), a change occurs only if an entity has different properties at different times.²⁰ Consider a process *a* that has property *F* at time *t* and a different property *F'* at a different time *t'*. Let *p_a* and *p'_a* be the temporal parts of *a* that span respectively *t* and *t'*, so that *p_a* is *F* and *p'_a* is *F'*.²¹ (For example, the opening scene of a film is funny and the closing scene is sad.) Mellor continues:

But now *F* and *F'* are properties of different entities, *p_a* and *p'_a*, and that stops this being a change, since change needs identity as well as difference. That is, it needs a single particular for the difference to be a change *in*; and here there is no such particular. ... [T]he difference between [*p_a* and *p'_a* is not] a change in *a*, the whole of which *p_a* and *p'_a* are parts, since *a* as a whole is never either *F* or *F'*; and nothing can change from having one property to having another if it never has either. (Mellor 1998: 89, 90.)

In response—and following a common strategy—I contest the claim that *a* is never either *F* or *F'*: Mellor himself says that '*a* is *F* at *t*, and ... *a* is *F'* at *t'*' (1998: 89).²² Mellor tries to bolster his reasoning by means of an analogy: 'compare *p_a* and *p'_a* with Jim and his grandson Jake, who ... has a different blood group.... [T]his difference between them is not a change ... in their family, which, as a whole, has no one blood group' (1998: 89, 90). The analogy fails, however. This much is right: although we say that Jim, a member of the family, has a certain blood group, we don't say that the family has a certain blood group 'at Jim'. But in the case of a process *a*, *in addition* to saying that *p_a*, the temporal part of *a* that spans *t*, is *F* (e.g., the opening scene of a film is funny), we—including Mellor—do say that the process '*a* is *F* at *t*' (e.g., the film is funny in the beginning).²³ So Mellor's reasoning fails to show that the past and other processes cannot change. I conclude that both four-dimensionalist theories of change like Lewis's and three-dimensionalist theories of change like Mellor's lead naturally to the claim that the past changes if there is a qualitative difference between different temporal parts of the past.²⁴

Given the above background on standard theories of change, it can be seen that according to such theories replacing the past does not count as changing it: replacing the past does not amount to making it the case that the past has different properties at different times, and (thus) does not amount either to making it the case that there is a qualitative difference between different temporal parts of the past. To address this objection to my claim that changing the past is legitimately understood as replacing it, consider what happens when a new government takes office: the government *changes*. This is not to say that the old government is *transformed* into the new one; it is rather to say that the old government is *replaced* with the new one. As another example, when I change the light bulb in my bedroom, I don't *transform* an old light bulb into a new one; I rather *replace* one light bulb with another. It's true that standard theories of change deal with transformation and not with replacement, and this may motivate Lewis to say that replacement is not 'genuine' or 'literal' change. But it's also true that both transformation and replacement are legitimate senses of 'change'.²⁵ So to those who object that, according to their theories of change, replacement does not count as change, my reply is: 'there are more legitimate senses of "change" than are dreamt of in your philosophy'.

In response one might grant that *ordinary* replacement counts as change but might argue that replacing *the past* is significantly different: ordinary replacement takes place *over time* in the *actual* world, whereas to replace the past I would need to replace certain actual past events with *simultaneous nonactual* ones. I reply that, along with these differences, an important similarity exists: in both kinds of replacement a definite description ('the light bulb in my bedroom', 'the past')²⁶ would have a denotation different from its present, actual one if the replacement took place. I take this similarity to be enough for replacing the past to count as changing it,²⁷ and Lewis himself comes close to conceding a related point:

What you *can* do is to change the present or the future from the unactualized way they would have been without some action of yours to the way they actually are. (Lewis 1976: 150.) That is something like change. We make a difference. But it is not literally change, since the difference we make is between actuality and other possibilities, not between successive actualities. (Lewis 1979: 38.) And [a time traveler] can certainly do as much; he changes the past from the unactualized way it would have been without him to the one and only way it actually is. To "change" the past in this way, [he] need not do anything momentous; it is enough just to be there, however unobtrusively. (Lewis 1976: 150.)

Lewis is talking about replacing a *nonactual* with the *actual* past, and he comes close to conceding that it's natural to call this a 'change' (despite, I add, its differences from ordinary replacement). He raises two worries, however. The first I have already dealt with: it's that (according to his theory of change) only a

difference between temporal parts ('successive actualities') counts as change. The second worry, namely that this kind of change is trivial, does not apply to replacing the *actual* with a *nonactual* past: rather than being trivial, this never *in fact* happens, and it might even not be clear yet (see Section 4) whether it *could* happen. I see then no obstacle to concluding that replacing the past counts as changing it.

4. From Affecting to Replacing the Past

If it is possible to affect the past, then it is possible to replace the past. My argument for this claim has just one premise: 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—'incompatible' in the sense that there is no possible world in which *both* effects obtain. For example: if there is a possible world in which a time traveller from 3000 destroys the Statue of Liberty at a time t in 2000, then there is also a possible world in which a time traveller from 3000 prevents the destruction of the Statue of Liberty at t . I don't have a general argument in support of the premise, but I don't see how one could plausibly contest it. Given the premise, here is my reasoning for the conclusion that it is possible to replace the past if it is possible to affect it. Suppose it is possible to affect the past: there is a possible world w in which, at some time t , an action is performed which has a causal effect e on the past of t in w . Given the premise, there is then also a possible world w' in which an action is performed at t which has a causal effect e' , incompatible with e , on the past of t in w' . Given that e and e' are incompatible, they don't both obtain in any possible world, so in particular they don't both obtain in α , the actual world. It follows that at least one of them, say e' , does not obtain in α . But then it is possible to replace the past: there is a possible world, namely w' , in which an action is performed at t which makes the past of t in w' different from the past of t in α (since e' , a causal effect of the action, obtains in w' but not in α). QED.²⁸

Even if one is unable to find fault with the above reasoning, one might object to its conclusion by appealing to an asymmetry between the past and the future. Necessarily, the future is not yet actualized but the past already is (cf. Hasker 1989: 123). So even if it is possible to replace (now) the future, to actualize a nonactual future, it is not possible to replace the past, to actualize a nonactual past: necessarily, it is now *too late* for the latter. In reply distinguish two senses of 'actualized' (cf. Dummett 1954: 40; Mackie 1966: 459). (1) In a first sense, an event is actualized when it *occurs*. In this sense it is indeed necessary that the future is not yet actualized but the past already is: necessarily, no future event has yet occurred but every past event already has. This necessity, however, poses no problem for the claim that it is possible to replace now the past, namely the claim that there is a possible world w in which an action is

now performed which makes the w -past different from the α -past: although the α -past has already occurred in α and the w -past has already occurred in w , maybe the w -past differs from the α -past partly as a result of an action now performed in w . (2) In a second sense, an event is actualized when it is *caused* (i.e., when its earliest cause occurs).²⁹ If backward causation is possible, however, then it is possible that some events are caused *after* they occur, and then in this second sense (to which I restrict myself from now on) it is possible that the past is not yet fully actualized because some past events have not yet been caused. But then the above objection (to my claim that replacing the past is possible *if* affecting it is) fails because it relies on a premise which is false if (affecting the past and thus) backward causation is possible: the premise that, necessarily, the past is already (fully) actualized.

Some people may still have a hard time seeing how it could be possible to replace the past: even if the past is not yet fully actualized, so that it is possible to actualize—i.e., cause—as yet uncaused events which have *in fact* occurred (i.e., to affect the past), it seems still impossible to actualize any events which *could* have occurred but did not occur (i.e., to replace the past). In response let me emphasize two important distinctions. Suppose that a past event e (which has already occurred) will be caused by some future event c (which has not yet occurred but will occur). Consider an event e' which could have occurred but did not occur and which is incompatible with e . (1) I grant that e' *will not* be actualized: as I said in Section 2, one never *in fact* replaces the past. It does not follow, however, that it is *impossible* to replace the past. (2) I also grant that any total (i.e., past, present, and future) history in which some future event c' causes e' is not *compossible* with the actual past history (in which e occurs, an event incompatible with e'). It does not follow, however, that no such total history is *possible*. Those who have a hard time seeing how it could be possible to replace the past should remember that the relevant question is about possibility, not about actuality or about compossibility with the actual past history.³⁰

Three paragraphs ago I gave an argument for the conclusion that it is *possible* to replace the past if it is possible to affect it. A parallel argument supports the conclusion that at least in some cases I *can* replace the past if in many cases I can affect it. (I *can* in the sense that I have the power, I have both the ability and the opportunity. I cannot do everything that it is possible for me to do: it is—logically—possible that I jump to the moon, but I cannot jump to the moon.) The parallel argument has just one premise: if I can have a given causal effect on the past, then in many cases I can also have a different, incompatible causal effect on the past. For example: if I can go back to 2000 and destroy the Statue of Liberty at a time t , then in many cases I can also go back to 2000 and prevent the destruction of the Statue of Liberty at t .³¹ (I only say 'in many cases'

because clearly there are possible scenarios in which I can destroy but I cannot prevent the destruction of the Statue of Liberty at t ; e.g., scenarios in which someone over whose actions I have no control is ready to destroy the Statue at t if I don't.) Given the premise, here is my reasoning for the new conclusion. Suppose that in many cases I can affect the past. Then it is likely that at least one of these cases falls within the scope of the premise; i.e., it is a case in which I can perform an action a which would have a causal effect e on the past, and I can also perform an action a' which would have a causal effect e' , incompatible with e , on the past. Given that e and e' are incompatible, at least one of them, say e' , does not in fact obtain. But then I can replace the past: I can perform an action, namely a' , which would make the past different from the actual past (since a' would cause e' , which does not in fact obtain). Note that, in contrast to the argument about possibility, which was deductively valid, the present argument is only inductively strong.³²

(The above counterfactuals are *back-tracking* (Lewis 1979: 34). As Lewis (1994: 482f) says, in a different context: 'It's not that ... the [past] would change retrospectively. Rather, it would never have been what it actually is, and would always have been something different.'³³)

5. Conclusion

I have distinguished two senses of 'changing the past': *transforming* and *replacing* the past. The widespread agreement that changing the past is impossible captures the truth that transforming the past is impossible. I have argued, however, that if *affecting* the past is possible (as many philosophers think it is), then so is replacing the past; and that if in many cases I can affect the past, then at least in some cases I can also replace the past. Maybe, then, I *can* now prevent the declaration of love which I actually made in 1987. More precisely, since my power to prevent the declaration may depend on things like my access to a time machine, my claim is that maybe it is *possible* that I can now prevent the declaration (hence the title of this paper).

Some people might take this paper to be an exercise in futility: even if I *can* now prevent the declaration of love, what is the point of telling me this since I am (and I remain after being told) justifiably certain that I *will not* prevent it? In response consider an analogy with the future: if I am justifiably certain that my crystal ball is perfectly reliable and I learn from it that I will be dismissed from my job due to poor performance, what is the point of telling me that I can prevent my dismissal? The point may be to let me know that the dismissal will be my own fault: it is in my power to prevent it, but I will not exercise this power. At least in some cases, it will be my own choice: no futility need be involved.³⁴ Similarly, the point of telling me that I can now do something which would prevent the declaration of love in 1987 may be to let me

know that my failure to prevent the declaration will be my own choice: I have my chance, but I will pass it up. It makes sense for me to cry over spilt milk if it is in my power to unspill it.³⁵

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NOTES

1. On the physics of time travel see: Arntzenius and Maudlin 2002; Davies 2002; Earman 1995a, 1995b: ch. 6, 1995c; Gott 2001; Nahin 1999; Novikov 1998: ch. 14; Pickover 1998; Thorne 1994: ch. 14.

2. On the distinction between affecting and changing the past see: Brier 1973: 361, 1974: 27f; Casati and Varzi 2001: 582f; Cook 1982: 51; Dwyer 1977: 384f; Forrest 1985: 216; Grey 1999: 65; Hanley 1997: 205f; Nahin 1999: 269–85; Richmond 2004: 177; Smith 1997: 366, 1998: 156. Instead of talking about *affecting*, some authors talk about *influencing* (Gilmore 1997: 34; Horwich 1975: 435f, 1987: 116, 1998: 418) or *participating in* (Blumenthal, Curley, and Williams 1988: 18f) the past. See also: Dowe 2000: 444; Dwyer 1975: 344f; Fulmer 1980: 151, 1983: 33; MacBeath 1982: 410f; Mavrodes 1984: 143f.

3. Concerning my use of 'the past' as a singular term: (1) According to presentism, the past no longer exists. Still, it existed, so on standard theories of reference I can refer to it. (Keller and Nelson (2001) argue that, if time travel is compatible with four-dimensionalism and presentism is consistent, time travel is also compatible with presentism. Cf. Dowe 2000: 443f; Monton 2003.) (2) According to the General Theory of Relativity, in spacetimes that allow time travel it makes no sense to speak of the past. More precisely: chronology-violating spacetimes possess no global time function. Still, my claims make sense if understood as being about the *local* past. (3) In this paper I don't deal with parallel universe theories (cf. Deutsch 1997; Deutsch and Lockwood 1994; Leslie 1989: ch. 4) or with multidimensional time models (cf. Goddu 2003; Meiland 1974; Oppy 2004; Richmond 2000; Wilkerson 1973).

4. On the debate concerning the possibility of backward causation, see especially the reviews by Brier (1974) and Nahin (1999: 191–8, 276ff).

5. I say 'in some cases' because I also affect the past if I cause the *non*-occurrence of a change in the past (e.g., I prevent a door from being opened).

6. More generally, for any times t_1 and t_2 such that t_1 is not later than t_2 , at t_2 I change the past of t_1 exactly if at t_2 I perform an action which makes the past of t_1 different from what it is. (Similarly for affecting the past.) Cases in which t_1 is later than t_2 are uninteresting; e.g., it is easy to affect now the past of 3000.

7. Cf. Lewis 1979: 38. If such talk makes sense, then talk of changing or even transforming the past need not be nonsensical (contrast Anscombe 1963: 48). On some views, the past of t before the action does not include the action but the past of t after the action does; then the action changes the past of t by *extending* it (cf. Goddu 2003: 17). Even on such views, however, no matter what action I perform at t , I don't change the past of any time *earlier* than t .

8. Or a counterpart of mine. I omit this qualification in the sequel.

9. It does not follow that, in w , if I had not performed the action, the past of t

would have been the *same* as the past of t in α : maybe in w if I had not shouted in 2005 something else would have caused the avalanche in 1987 (assume the avalanche does not occur in α).

10. One might argue that there are also two other ways to understand the statement that it is possible that I change the past:

(P3) There is a possible world w in which, at some time t , I perform an action which makes the past of t in α different from what the past of t in w is.

(P4) There is a possible world w in which, at some time t , I perform an action which makes the past of t in α different from what the past of t in α is.

Assuming, however, that an action performed in a given world has no causal effect which occurs in a different world, P3 and P4 are necessarily equivalent to P0:

(P0) In α , at some time t , I perform an action which makes the past of t in α different from what the past of t in α is.

P0, which is an instance both of P1 and of P2, is materially equivalent both to the statement that I in fact transform the past and to the statement that I in fact replace the past.

11. Alternatively, they may be using 'the past' only rigidly: they may be rejecting P4 (see note 10).

12. By 'different' I mean 'different in *some* respect': my action need not be causally responsible for *all* differences between the past of 2005 in w and the actual past of 2005. Maybe, for example, in w the Roman Empire never exists, and this is not a result of my pushing the button in 2005.

13. Some branching time theorists will reject this supposition: they say that, because there are many future histories, 'there is no more sense to "the actual future" than there is to ... "the odd prime number"' (Belnap, Perloff, and Xu 2001: 208). But although I think that the analogy with the future is helpful, it is not essential to my reasoning; branching time theorists typically accept that there is a unique past history, so they need not have a problem with my talk of replacing *the* actual past with a nonactual one.

14. Why assume I am certain that this death will occur? Because without this assumption (1) the case is not analogous with typical cases about the past and (2) it cannot be properly said that I want to *change* the future (since I am not certain that the future I want to bring about is nonactual).

15. I am not denying that non-confused people sometimes have incoherent desires, for example to disprove Fermat's Last Theorem; I am rather denying that they have desires they *realize* are incoherent. (Arguably they may have *wishes* they realize are incoherent, but that is a different matter.)

16. Lewis says 'enduring', but later on (1986: 202) he adopted the—now standard—claim that *perduring* things have temporal parts but *enduring* things do not.

17. Cf. Lewis 1979: 37f. See also Smart 1958: 76, 1981: 149.

18. Ultimately I don't want to grant this: if replacing the actual past with a nonactual one counts as changing the past, why shouldn't replacing the actual events of a past moment with nonactual ones count as changing the events of that past moment?

19. Note that I understand the past as consisting of the *events* of all past moments, not as consisting of all past *moments* (contrast Mellor 1998: 9).

20. Mellor calls 'events' what I call 'processes' (1998: 85). Although, unlike Lewis, Mellor says that 'differences between temporal parts fail to be changes' (1998: 90), Mellor agrees with Lewis that things can change, because (unlike Lewis) he says that 'things ... lack temporal parts' (1998: 85).

21. Following Mellor, I say 'span' because I use 'times' to refer not only to *moments*, but also to *intervals*.

22. Strictly speaking, Mellor's claim is that *a as a whole* is never either *F* or *F'* (cf. Simons 1987: 135f); but if this is understood as distinct from the claim that *a* is never either *F* or *F'*, to respond to Mellor I need to contest only the latter claim.

23. For further discussion, and for points related to Mellor's, see: Geach 1965: 304; Heller 1992: 698–704; Lombard 1986: 108f, 1994: 369–72; Sider 2001: 212–6; Thomson 1983: 210f.

24. To make it the case that there is a qualitative difference between different temporal parts of the past is to cause the occurrence of a change in the past, and this is to *affect* the past. So the above conclusion may have the consequence that, according to standard theories of change (though contrary to what, following standard practice, I said in Section 2), some instances of *affecting* the past count as changing it. I am not averse to accepting that affecting the past is yet another legitimate sense of 'changing the past' (though a qualification is needed given note 5), but accepting this would require modifying the definition of 'changing the past' I gave in Section 2. Cf. Dowe 2000: 444 n. 14.

25. Moreover, they are recognized to be so by standard dictionaries (e.g., Brown 1993; Procter 1995). Further examples of change as replacement: 'Please note my change of address'; 'You have five minutes for a change of costume'. In response one might argue that cases of replacement are analysable in terms of transformation: when the government changes, the country undergoes a transformation. I reply first that no unique government undergoes then a transformation, but we do say that *the government* changes. Moreover, arguably some cases of replacement are not analysable in terms of transformation: 'The operator "–" changes 1 to –1' (thanks to a referee for this example). So I would insist that replacement and transformation are distinct senses of 'change'.

26. I think that 'the past' is *normally* used as a definite description (something like 'the collection of all past events') and is then a nonrigid designator. This does not conflict with my claim (see Section 2) that 'the past' *sometimes* stands for 'the past in α ' and is then a rigid designator.

27. One might object that, although the definite description 'my youngest child' would have a denotation different from its present, actual one if I were to beget one more child, I would not thereby change my youngest child. I reply that I would not thereby replace my youngest child either: I am only claiming that certain cases of *replacement* count as changes (namely cases in which a definite description would have a denotation different from its present, actual one if the replacement took place).

28. In conjunction with the reasonable assumption that affecting the past is possible if backward causation is, the conclusion of the above reasoning entails that replacing the past is possible if backward causation is.

29. Some people might claim that an event is caused when *it* occurs, not when its earliest *cause* occurs. I disagree, but I need not take a stand: these people should disregard the parenthetical remark 'i.e., when its earliest cause occurs' and should take the second sense of 'actualized' to be the same as the first. Other people might claim that causation is a *relation* between events and thus takes place at no particular time (Keller and Nelson 2001: 341). These people should take an event to be actualized in the second sense when its earliest cause occurs, not when it is caused.

30. I understand the actual past *history* as a *proposition* describing the actual *past* (which consists of *events*: see note 19).

31. In response one might argue that the above conditional is true but trivial because its antecedent is false: given that the Statue of Liberty was not destroyed in 2000, I cannot now go back to 2000 and destroy it. In reply I ask: why can't I? If one answers that it is because hard determinism is true and thus I can do only what I in fact do, I grant that my premise presupposes the falsity of hard determinism. But if one answers that it is because destroying the Statue of Liberty would change the past and it is impossible to change the past, I respond that destroying the Statue would *replace* the past and I have already argued that it is possible to replace the past if it is possible to affect it (see also Vranas 2005).

32. Vihvelin (1996) argues that a time traveller cannot kill her younger self (because she would fail if she—repeatedly—tried), but grants that her argument—which Sider (2002) and Vranas (2005) try to refute—does not show that a time traveller cannot kill Hitler (and thus does not show that one cannot replace the past).

33. According to 'multiple-pasts' (Fischer 1986: 34; Kane 1996: 49) or 'altered-past' (Horgan 1985: 343; Mackie 2003: 683) compatibilism, it is possible that I have *counterfactual power* over the past, in the sense that I can perform an action such that, if I were to perform it, the past would have been different from what it is. Moreover, the claim that I have counterfactual power over the past has been distinguished from the claim that I can transform the past (e.g., van Inwagen 1983: 42). So one might argue that, rather than being novel, my distinction between transforming and replacing the past is old hat in the literature on compatibilism. I reply that my distinction differs from the one in that literature: the possibility of backward causation is entailed by the possibility of replacing the past but—as is often recognized in the literature—is not entailed by the possibility of counterfactual power over the past (cf. Davies 1983: 323f; Fischer 1983: 130f, 1984: 335, 1986: 35; Foley 1979: 73; Ginet 1983: 397; Horgan 1985: 348; Kane 1996: 49; Lehrer 1980: 199; Mackie 2003: 683; Narveson 1977: 85; Saunders 1968: 102; Vihvelin 1991).

34. (See also: Casati and Varzi 2001; Goddu 2002; Sobel 1966: 80–3.) This is not to deny that in *other* cases it will *not* be my own choice: I will do my best, but I will be unlucky. The crystal ball example also addresses an objection (to the claim that I can now prevent the declaration of love) based on Gallois's (1977: 103f) suggestion that, if it is pointless for me to deliberate about whether to do something, then I cannot do it.

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