HOW TO KNOW THAT TIME TRAVEL IS UNLIKELY WITHOUT KNOWING WHY

BY

KATRINA ELLIOTT

Abstract: What’s the point of time travel? Not to change the past; no matter how carefully a time traveler plans, all of her attempts to change the past end in failure. Paul Horwich has argued that the implausibility of such failures gives us reason to doubt that there will be frequent time travel to the local past. I defend a modified version of Horwich’s argument and show how we might gain evidence about the chance of there being frequent time travel in the future without having any information that explains why that chance value obtains.

1. Introduction

I admire Paul Horwich’s *Asymmetries in Time* and I wish I’d published it.1 As it happens, I have a working time machine and no moral compass, and so I travel back to 1986 with the intention of Scooping Horwich. I bring along my copy of *Asymmetries in Time*, duplicate it with a typewriter upon my arrival, and set about trying to publish the duplicate under my name. Despite my good planning and bad intentions, Horwich has nothing to worry about. It is true that Horwich published *Asymmetries in Time* in 1987, and so it is not true that I prevent Horwich from publishing *Asymmetries in Time* by scooping him in 1986. Not even time machines make contradictions true.

Some (e.g., Asimov, 2003) have wondered whether cases like this one, in which a time traveler attempts to change the past, show that time travel to the local past is impossible. On the one hand, if time travel is possible, then
I can, for instance, prevent Horwich from publishing *Asymmetries in Time* by scooping him in 1986; it will not be hard to get such an excellent and as of yet unpublished manuscript into print. On the other hand, if time travel is possible, then I cannot prevent Horwich from publishing *Asymmetries in Time*; it is true that Horwich published *Asymmetries in Time* in 1987, and so my attempt to scoop him cannot succeed on pain of contradiction. It seems that the supposition that time travel is possible has led to the absurdity that I both can and cannot prevent Horwich from publishing *Asymmetries in Time*.

But modal terms are easy to equivocate. David Lewis argues that ‘to say that something can happen means that its happening is compossible with certain facts’, and senses of ‘can’ vary with which set of facts context determines (Lewis, 1976, p. 149). On Lewis’s view, I can prevent Horwich from publishing *Asymmetries in Time* relative to, for example, my means and motives, but I cannot prevent Horwich from publishing *Asymmetries in Time* relative to, for example, the fact that Horwich publishes *Asymmetries in Time*. Because there is no univocal reading of ‘can’ on which the possibility of time travel implies that I both can and cannot succeed, the supposition that time travel is possible does not, after all, imply an absurdity.

Still, it is hard to shake the feeling that there is something strange going on in stories about time travelers who attempt to change the past. No matter how many times I try, I will not scoop Horwich. What stops me? I send one duplicate of *Asymmetries in Time* to a publisher but it gets lost in the mail. I send a second duplicate just to be safe but the publisher misplaces it. On the way to deliver a third duplicate by hand, I slip on a banana peel while crossing the street. We know that submitting a manuscript for publication is an easy process that is unlikely to fail, so it is puzzling that I am having so much trouble. It is unlikely for manuscripts to be misplaced, for mail to be lost, and for people to slip on banana peels, but unlikely events such as these (and more, if I continue with my scooping attempts) occur if I travel back to 1986 and attempt to scoop Horwich. Generalizing on this line of thought, Horwich (1987) argues that, given the empirical claim that people will attempt to change the past if they have access to time travel, people will at most rarely travel to their local past because such travel involves implausible failures to complete simple tasks.² This rarity, Horwich presses, calls for explanation. Why will people at most rarely travel to their local past? We ought not answer that a series of unlikely failures (e.g., time travelers tripping on the way to their time machines) just happens to prevent such travel, for we gain nothing by replacing one objectionably unlikely story with another. Instead, Horwich concludes that there is some fact that systematically prevents time travel (where ‘to prevent’ is to make at least unlikely). Perhaps, for example, the structure of space–time does not allow for travel to the local past, or the fuel costs associated with frequent time travel to the local past are prohibitively steep, or time machines are too complicated for intellects like

© 2018 The Author
Pacific Philosophical Quarterly © 2018 University of Southern California and John Wiley & Sons Ltd.
ours to invent, or international legislation prevents time travel. Horwich’s argument does not tip us off as to what feature of our world prevents time travel, but it purports to show that our proclivity toward changing the past is a (defeasible) reason to think that our world has such a feature.

If Horwich’s reasoning is correct, we can acquire evidence about whether anything in our world prevents time travel to the local past by investigating whether time travelers would try to change the past. That’s a surprising and philosophically interesting result; one might have thought that, say, facts about my psychological proclivity toward scooping prominent philosophers if given access to time travel, facts about the efficiency of the U.S. Postal Service, facts about academic publishing, and so on, combine to tell us nothing whatsoever about my prospects for traveling to my local past. But while such facts tell us nothing about what prevents my time traveling, Horwich’s argument implies that these facts are nevertheless evidence that something does. The strangeness of Horwich’s argument is a bit like the strangeness of Hempel’s paradox of the ravens (Hempel, 1945). To paraphrase Nelson Goodman (1955), the paradox of the ravens is strange because it seems to imply that we can acquire evidence about the truth of some proposition by investigating matters that are seemingly irrelevant to that proposition; we can, for example, study ornithology without ever going outside. Similarly, Horwich’s argument is strange because it seems to imply that we can learn about whether our world is conducive to time travel without knowing a thing about physics, but rather by, for example, asking folks what they would do if they had time machines. Just as the question of how to resolve the paradox of the ravens is of philosophical interest even if the color of ravens is not, the question of whether Horwich’s reasoning is correct is of philosophical interest even if we have independent reason to think that time travel is, or is not, unlikely.

I will argue that, with some amendment, Horwich’s reasoning is correct; there is an evidentiary relationship between the proposition that an individual is motivated to change the past and the proposition that the individual does not travel to the local past because such travel is at least unlikely – the former, when combined with various other commonly held background beliefs, is evidence for the latter. That Horwich’s reasoning is good will be easiest to see after it is analogized to some less controversial reasoning about a non-time travel scenario, which I call ‘Four Roads’ and present in Section 2. In Section 3, I offer an amended version of Horwich’s reasoning and justify that reasoning by analogy to my reasoning about Four Roads. In Section 4, I reply to four objections, three of which are inspired by objections targeted at Horwich’s original argument (from Smith, 1997 and Ismael, 2003) and one of which is specific to my amendment of Horwich’s argument (from John Roberts). Finally, I conclude in Section 5 by reflecting on the strangeness of the evidentiary relationships identified by my modification of Horwich’s argument.
Before critically evaluating Horwich’s reasoning about cases involving time travel, it will be helpful to consider some relevantly analogous reasoning about non-time travel cases. To warm up, suppose we are wondering whether a particular coin is fair or is heavily biased towards heads. Suppose further that, before tossing the coin, we have no evidence that favors either hypothesis over the other and that we are equally confident in each. Now we toss the coin ten times, and each time, it comes up heads. Had we believed that the coin was fair, we should have also believed that the coin was not likely to land heads ten times in ten tosses and so should not have expected that outcome. Had we believed that the coin was heavily biased toward heads, we should have also believed that the coin is reasonably likely to land heads ten times in ten tosses and so should have been reasonably confident in that outcome. Other things being equal, evidence confirms whichever hypothesis would have made us, had we believed it prior to learning that evidence, most confident in that evidence. So the fact that the coin lands heads ten times in ten tosses confirms the hypothesis that the coin is heavily biased towards heads over the hypothesis that the coin is fair.

Now consider a similar case, but one in which we are asked to pick between four hypotheses rather than two:

Four Roads: Yesterday I participated in a game, the object of which was to traverse a two-mile road. At the start of the game, I was exactly as prepared to complete a two-mile journey as I am when I leave the house on a typical day, which is to say that I was prepared for easy treks but not for difficult ones. According to the rules of the game, the road I faced was either hospitable or inhospitable, and either guarded or unguarded. Hospitable roads are paved, located in pleasant climates, flat, and nowhere near various environmental threats such as lava pits and jagged cliffs. Inhospitable roads are just the opposite: unpaved, located in extreme climates, composed of sheer climbs that give way to deep ravines, and near all manner of natural hazard. Guarded roads are manned with trained and armed guards who will attempt to prevent anyone they encounter from reaching the end of the road. Unguarded roads, whatever other dangers they might present, at least do not feature any agents who will try to stop me. Needless to say, I was hoping for a hospitable and unguarded road.

A reliable witness has informed you that, although she does not know whether I won the game, she is certain that exactly one of the following four outcomes occurred (and neither she nor you have any further information as to which):

(1) I faced a hospitable and guarded road, and I made it to the end.
(2) I faced an inhospitable and guarded road, and I made it to the end.
(3) I faced a hospitable and unguarded road, and I did not make it to the end.
(4) I faced an inhospitable and unguarded road, and I did not make it to the end.

Assume that, prior to narrowing down the possible outcomes to one of (1)–(4), you were equally confident in each of the four mutually exclusive and collectively exhaustive hypotheses about what sort of road I faced. The reliable witness’s testimony has ruled out two kinds of outcomes:
that I failed to make it to the end of a guarded road, and that I made it to the end of an unguarded road. In light of the evidence provided by the witness's testimony, what kind of road should you expect me to have faced?

First, you now know that if I faced a hospitable but guarded road, then I made it to the end. Based on what you know about typical human physiology, the mechanics of small arm weapons, etc., you should think that it was unlikely for me to make it to the end given that I faced competent and armed guards. So you know that if I faced a hospitable and guarded road, then an unlikely outcome occurred – I was likely to fail but I succeeded.

Second, you know that if I faced an inhospitable and guarded road, then I made it to the end, that is, I not only managed to evade armed guards but I also overcame two miles of treacherous terrain. Given what you know about the difficulties typical humans face in, for example, climbing steep ridges in the freezing cold and navigating narrow canyon paths in brutal heat, you should think that it was unlikely that I made it past the guards and through the difficult environment. So you know that if I faced an inhospitable and guarded road, then an unlikely outcome occurred – I was likely to fail but I succeeded.

Third, you know that if I faced a hospitable and unguarded road, then I did not make it to the end. You have no reason to think that I am any great athlete, but, given what you know about typical human physiology, you should think that it was unlikely for me to fail to travel two miles in a pleasant environment with no agents trying to stop me. So you know that if I faced a hospitable and unguarded road, then an unlikely outcome occurred – this time because I was likely to succeed and yet failed.

Finally, you know that if I faced an inhospitable and unguarded road, then I did not make it to the end. While there were no guards to stop me on this outcome, I nevertheless faced two miles of dangerous and difficult environmental obstacles. Given what you know about typical human physiology, you should think it was at least somewhat likely that I fail to make it to the end given that the road was inhospitable. Failure in the face of an inhospitable road is much more likely than is either failure in the face of a hospitable and unguarded road or success in the face of a guarded road. So you know that if I faced an inhospitable and unguarded road, then an at least comparatively likely outcome occurred – I was reasonably likely to fail and I did.

To summarize, you have four hypotheses about the sort of road I faced yesterday from which to choose. On three of those hypotheses (i.e., that the road was hospitable and guarded, that the road was inhospitable and guarded, and that the road was hospitable and unguarded), an unlikely thing happened. Because you should be skeptical that any particular unlikely event occurs, you should have been skeptical than one of (1)–(4) is true had you believed any of those three hypotheses prior to learning the
witness’s testimony. On the fourth hypothesis (i.e., that the road was inhospitable and unguarded), a comparatively likely thing happened. Had you believed that hypothesis prior to learning the witness’s testimony, you should have been comparatively confident that one of (1)–(4) is true (because you should have been comparatively confident that (4) is true). Because you have no other information that favors any hypothesis over the remaining three, you should be most confident in the hypothesis that, had you believed it prior to learning that one of (1)–(4) is true, would have made you most confident that one of (1)–(4) is true: the hypothesis that I faced an inhospitable and unguarded road. Finally, because you know that if I faced an inhospitable and unguarded road, then I did not make it to the end, you should be at least as confident that, unfortunately but not improbably, I failed to make it to the end. The witness’s testimony that one of (1)–(4) is true, then, is evidence that I failed to traverse an inhospitable and unguarded road.

My strategy for the rest of the paper will be to argue that Horwich’s reasoning about time travel cases is of the same kind and quality as is the above reasoning about Four Roads. I take it that most of my reasoning about Four Roads is familiar and unambiguous, except perhaps for the notion that some events (such as my making it to the end of an inhospitable and guarded road) are ‘unlikely’, while other events (such as my making it to the end of a hospitable and unguarded road) are ‘likely’. Probabilistic concepts such as these can be interpreted in many importantly different ways. When I use ‘unlikely’, ‘likely’, ‘probable’, and ‘improbable’ throughout this essay, I mean to refer to a kind of probability that philosophers sometimes call ‘macro-chance’. Despite the unwieldy name, macro-chances are arguably the probabilities with which we are most familiar. When we speculate, for example, that the next U.S. president will probably be a woman, that the Royals are likely to make the playoffs, and that the ace of spades has very little chance of being the first card dealt from a well-shuffled deck, we are invoking macro-chances. And macro-chances do not just feature in our commonsense theories – mature sciences, such as thermodynamics and evolutionary biology, (arguably) investigate the macro-chances of various phenomena.

Not much can be said about macro-chance without courting controversy. My reasoning about Four Roads (and later about time travel cases) assumes that there are macro-chances and that macro-chance is distinct from three features of the world that can also be modeled with probabilities: actual relative frequency, micro-chance, and degree of confidence. I explain these assumptions below and direct the reader toward some authors who defend them, but I won’t offer any independent arguments here. I will be content to show that a version of Horwich’s reasoning about time travel is no worse off than is my reasoning about Four Roads; any outstanding objections that come from broad disagreement about the nature of macro-chance rather than from local disagreement about the nature of time travel are beyond the scope of this discussion.
First, macro-chance is distinct from actual relative frequency; the frequency with which an outcome occurs (relative to the total number of occurrences) need not match that outcome’s macro-chance of occurring. For example, the macro-chance that a quarter lands heads when properly tossed is .5. However, the frequency with which a quarter lands heads among a sequence of tosses need not be .5 because, for example, the quarter might never be tossed or might not be tossed an even number of times or might never land on heads, and so on. My reasoning about Four Roads invokes, for example, the macro-chance that I will evade armed guards rather than the actual frequency with which people relevantly similar to me have actually evaded armed guards. Accordingly, the reasoning in Four Roads is not impugned even if, by some fluke of luck, people time and time again evade guards to make it to the end of the road (provided that the macro-chance of each success truly is low).

Second, macro-chance is distinct from micro-chance, which is (arguably) modeled by the probabilities that appear in fundamental physical theories such as quantum mechanics. That the two are distinct is easiest to see when we consider worlds with non-extremal macro-chances but extremal micro-chances. If our world is fundamentally deterministic, then all micro-chances take extremal values of either 0 or 1. However, both our commonsense and scientific theories allow for fundamentally deterministic processes to underwrite non-fundamental, or ‘macro’, indeterministic processes. For example, common sense treats the underlying processes at work in poker games (i.e., shuffles and deals) as deterministic but nevertheless assigns a macro-chance of 1/52 to the proposition that the first card dealt from a well-shuffled deck is the ace of spades. And classical statistical thermodynamics assumes that the microevolution of a gas is governed by deterministic laws but assigns various non-extremal macro-chances to possible evolutions of a gas’s thermodynamic properties. To be sure, there are important and difficult questions about how there can be non-extremal macro-chances in worlds with only extremal micro-chances, but many philosophers (e.g., Loewer, 2001, Hoefer, 2007, Sober, 2010, Lyon, 2010, Emery, 2015) have argued that non-extremal macro-chances are compatible with fundamental determinism. I agree; I’ll assume, for example, that its being unlikely for me to evade many armed guards is compatible with both determinism and indeterminism at the micro-level. The important upshot is that my reasoning in Four Roads is not hostage to results about the micro-chances of our world.

Finally, macro-chance is distinct from an agent’s degree of confidence. It is often useful to use probabilities to represent an agent’s confidence that various propositions are true – the more (or less) confident an agent is in the truth of some proposition, the higher (or lower) is the value of the probability that models her doxastic attitude toward that proposition. Sometimes, we use such models to capture an agent’s actual doxastic attitudes,
but it should be clear that, for example, the fact that a quarter’s macro-
chance of landing heads is .5 implies nothing at all about any actual person’s
actual opinions. At other times, we use these probabilistic models to capture
what an agent’s doxastic attitudes should be given other facts about her,
such as her background beliefs. The value of these ‘rational’ degrees of
confidence sometimes diverge from the values of macro-chances because
the agent in question is ignorant of some relevant information, as when I
blamelessly expect that I will win the lottery because I’ve been misinformed
about the number of tickets that I own.

While macro-chances are distinct from rational degrees of confidence,
the former constrain the latter; with exceptions, an agent’s degree of
confidence in an outcome should be equal to what she believes the
macro-chance of that outcome to be. The exception cases are ones in which
an agent has information that, in some vague but intuitive sense, ‘goes
beyond’ its macro-chance. David Lewis called such information
‘inadmissible’ and introduced the idea that agents are not required to align
their degrees of confidence with chances when they have inadmissible
information.10 Four Roads provides several examples in which an agent
is not obligated to align her credences to what she takes the macro-chances
to be. For instance, the macro-chance that I will get to the end of a guarded
road is low. Prior to knowing that one of (1)–(4) is true, you should have
been skeptical that I would make it to the end of a guarded road because
my making it to the end of a guarded road is unlikely; you have no
inadmissible information and so should align your degrees of confidence
with (what you take to be) the macro-chances. However, were you to have
gained the additional information that one of (1)–(4) is true, you should
have been confident that I make it to the end of a guarded road despite
its being unlikely. The eyewitness testimony about whether I made it to
the end contains inadmissible information that ‘goes beyond’ the mere
macro-chance of my making it to the end, and so once you have that infor-
mation, you are no longer obligated to match your credence in my making
it to the end with my macro-chance of making it to the end. Accordingly,
although you should indeed be skeptical that I make it to the end and you
should be confident that I was unlikely to make it to the end, your reason
for being skeptical that I make it to the end should not be that it was
unlikely. Instead, that one of (1)–(4) is true is evidence both that it was
unlikely for me to make it to the end (because it is evidence that the road
was inhospitable and unguarded) and that I did not make it to the end
(because I do not make it to the end if the road is inhospitable and
unguarded). In summary, my reasoning about Four Roads requires
inferences from macro-chances to rational degrees of belief only when we
have no inadmissible information (i.e., only when we are thinking about
what our degrees of belief should be prior to learning that one of (1)–(4)
is true).
3. Amending Horwich’s argument

3.1. SCOOPING HORWICH

Unlike my reasoning about Four Roads, Horwich’s original argument about time travel does not invoke macro-chance. Horwich writes,

Bilking, in the context of … time travel is bringing about some past event that did not occur, such as killing one’s infant self or doing something one remembers was not done. Now we know … that attempts at such things will invariably fail. But we recognize that there is considerable strangeness in this – something ad hoc and unsatisfying about explaining the repeated failures in terms of changes of mind, guns misfiring, and so forth. Since it is implausible that such mishaps would occur so faithfully over and over again, we conclude instead that there would not be frequent attempts to initiate self-defeating causal chains. (Horwich, p. 121)

Why is it ‘implausible’ that such mishaps would repeatedly occur? Horwich’s answer is that a correlation between an attempt to bilk and circumstances that would frustrate that attempt constitutes an ‘inverse fork’: a correlation between two events that is not screened off by a temporally prior third event (Horwich, 1987, p. 97–98). We typically observe correlations that do not constitute inverse forks. Barometer readings, for example, are correlated with the occurrences of storms but that correlation is screened off by prior changes in atmospheric pressure. In contrast, if I frequently attempt to scoop Horwich, then there will be a correlation between, say, my crossing the street on the way to the publisher’s and my slipping on a banana peel. Because that correlation is not screened off by any prior event, it constitutes an inverse fork. Horwich reasons that because we have not observed any occurrences of inverse forks in the past, we should not expect to observe many occurrences of inverse forks in the future.

It is important to Horwich’s overall project in Asymmetries in Time that he formulates his argument in terms of correlations and inverse forks rather than in terms of macro-chances. I am presently interested in finding the best version of Horwich’s argument, whether or not that argument is consistent with Horwich’s other commitments. To that end, I omit talk of correlations and inverse forks. Instead, on my version of Horwich’s argument, failures are ‘implausible’ in the sense that they are unlikely. I will use phrases such as ‘Horwich-style reasoning’ and ‘Horwich-style argument’ to remind the reader of the difference. So amended, Horwich’s reasoning about time travel cases has the advantage of being analogous to our earlier reasoning about Four Roads, as the following case helps to illustrate:

Scooping Horwich: Paul Horwich published Asymmetries in Time in 1987. I might attempt to scoop Horwich by publishing Asymmetries in Time in my name in 1986 or I might not. Furthermore, time travel to the local past might be hard for me or it might not be. Time travel is hard for me exactly on the condition that there is some state of affairs that prevents me from traveling to
my local past (in the sense that it is at least unlikely for me to time travel given that state of affairs). Examples of states of affairs that could prevent me from travelling to my past include the structure of space–time, the fuel cost associated with time travel, the accessibility of the relevant technology, and so on. For the time being, you have no evidence one way or the other about whether I attempt to scoop Horwich or whether time travel is hard for me.

Now you learn some additional information. First, you learn that I do not have the temerity to try to acquire Horwich’s unpublished manuscript of *Asymmetries in Time* prior to its publication in 1987 using conventional means such as cat burglary or bribery, and I’m not capable of having thought up *Asymmetries in Time* on my own; I will attempt to scoop Horwich only if I travel to 1986 having acquired a copy of *Asymmetries in Time* after its publication in 1987. Second, you learn that I am highly motivated to scoop Horwich given that I have access to time travel to my local past; if I time travel then I will attempt to scoop Horwich. Third, you learn that if I attempt to scoop Horwich then my attempt will be credible; I will not, for instance, attempt to scoop Horwich by burying a copy of his (as of yet) unpublished manuscript in my backyard rather than by delivering it to a publisher. In light of this new information, you now know that exactly one of the following four outcomes occurs:

1. I attempt to scoop Horwich and time travel is not hard for me. I do not scoop Horwich and I do time travel to my local past.
2. I attempt to scoop Horwich and time travel is hard for me. I do not scoop Horwich and I do time travel to my local past.
3. I do not attempt to scoop Horwich and time travel is not hard for me. I do not scoop Horwich and I do not time travel to my local past.
4. I do not attempt to scoop Horwich and time travel is hard for me. I do not scoop Horwich and I do not time travel to my local past.

Assume that, prior to narrowing down the possible outcomes to one of (1*)–(4*), you were equally confident in each of the four mutually exclusive and collectively exhaustive hypotheses about whether I attempt to scoop Horwich and whether time travel is difficult for me. Learning additional information about the conditions under which I will attempt to scoop Horwich and what I will do if given access to time travel has ruled out two kinds of outcomes: that I attempt to scoop Horwich without having time traveled and that I time travel without attempting to scoop Horwich. In light of this new information, what should you expect about whether I attempt to scoop Horwich and whether time travel is hard for me?

Scooping Horwich is an analogue to Four Roads in the sense that the same sort of reasoning that favored the hypothesis that I faced an unguarded and inhospitable road in Four Roads now, when applied to Scooping Horwich, favors the hypothesis that I do not attempt to scoop Horwich and that time travel is hard for me. Before highlighting the analogies between the cases, however, note that there is an obvious way in which the two are not analogous – in Scooping Horwich, unlike Four Roads, we learn that exactly one of (1*)–(4*) is true before some of the outcomes described by (1*)–(4*) occur. However, this is not a difference that makes a difference; the time at which new evidence is acquired is not relevant to the question of which hypothesis that evidence confirms. Recall, for
example, the case in which we are trying to decide between the hypothesis that a coin is fair and the hypothesis that a coin is heavily biased toward heads. The fact that the coin lands heads on every toss is evidence that the coin is heavily biased regardless of when we obtain that evidence. If a reliable time traveler testifies that the coin will land heads on every toss many years from now, we have just as much reason to suspect that the coin is heavily biased as we would have had we observed that outcome ourselves many years from now.

I now highlight the structural similarities between the two cases. In Four Roads, we consider four mutually exclusive and collectively exhaustive hypotheses about what sort of road I faced: the road was either hospitable or inhospitable and either guarded or unguarded. In Scooping Horwich, we consider four mutually exclusive and collectively exhaustive hypotheses about whether time travel is hard for me and whether I attempt to scoop Horwich: time travel is either hard for me or not, and I attempted to scoop Horwich or not. In both cases, we assume that you begin by being equally confident in each of those four hypotheses. In Four Roads, there are two possible outcomes to consider: that I made it to the end and that I did not. In Scooping Horwich, there are two possible outcomes to consider: that I failed to scoop Horwich and travelled to my local past and that I failed to scoop Horwich and did not travel to my local past. (That I succeeded in Scooping Horwich is ruled out by fact that Asymmetries in Time is published in 1987 by Horwich). In Four Roads, you acquire new evidence that rules out the possibility that I fail to make it to the end of a guarded road and the possibility that I make it to the end of an unguarded road, that is, you learn that exactly one of (1)–(4) is true. In Scooping Horwich, you acquire new evidence that rules out the possibility that I attempt to scoop Horwich and do not time travel and the possibility that I do not attempt to scoop Horwich and time travel, that is, you learn that exactly one of (1*)–(4*) is true. In both cases, you are asked which hypothesis to expect in light of the new information you have learned. So, in this myriad of ways, the setups to the two cases are analogues.

Comparing Scooping Horwich with Four Roads can help to prevent two mistakes we might otherwise make about Scooping Horwich. First, I take it that facts about whether or not I attempt to scoop Horwich and whether or not I succeed in Scooping Horwich are irrelevant to my macro-chance of eventually time traveling. For example, I take for granted that there is no mechanism whereby the act of submitting someone else’s work for publication somehow improves one’s odds of traveling through time; I would very much like to time travel one day, but I do not think that attempting to publish someone else’s work as my own will make any difference to my chance of meeting that goal. It can be easy to miss this point, because knowing that I attempt to scoop Horwich should (given our evidence) make us more confident that I time travel. However, as Four Roads illustrates, not every factor
that raises our confidence in the occurrence of some state of affairs does so by raising the macro-chance of that state of affairs; knowing that the road is guarded should (given our evidence) make us more confident that I make it to the end, but not because the road’s being guarded somehow increases my macro-chance of making it to the end. Second, I take it that the difficulty of time travel and whether one has time traveled does not make one’s attempt to scoop Horwich any more or less likely to fail. For example, I take it that there is no mechanism whereby mail sent by time travelers is less likely to reach its destination than is mail sent by the rest of us – how does the mail ‘know’ whether or not we’ve come from the future? Here again it might be easy to get confused, and here again it is helpful to remember Four Roads; we know that I fail to scoop Horwich if I travel back in time just as we know that I fail to traverse a two-mile road if it is unguarded, but being a time traveler no more interferes with my attempt to scoop Horwich than does a lack of guards interfere with my making it to the end of the road. Accordingly, I assume that the only varying factor relevant to my macro-chance of time traveling (as opposed to our expectation about whether I time travel) is whether or not time travel is hard, and I assume that the only varying factor that is relevant to my macro-chance of successfully Scooping Horwich (as opposed to our expectation about whether I succeed) is whether or not I make an attempt.

The final important analogy between the cases is that in Scooping Horwich, like in Four Roads, an unlikely outcome occurs on exactly three of the four hypotheses under consideration. As we did with Four Roads, let us consider each of the four hypotheses in turn. First, you know that if I attempt to scoop Horwich and time travel is not hard for me than I do not scoop Horwich and I do time travel to my local past.11 It is not unlikely that I time travel to my local past given that time travel is not hard, but it is unlikely that I fail to scoop Horwich given that I try; submitting manuscripts for publication is easy and publishers are eager to print quality manuscripts such as *Asymmetries in Time*. So you know that if I attempt to scoop Horwich and time travel is not hard than an unlikely outcome occurs. Next, you know that if I attempt to scoop Horwich and time travel is hard, then I do not scoop Horwich and I do travel to my local past. For the reasons just given, it is unlikely that I fail to scoop Horwich given that I make an attempt. Furthermore, it is also unlikely that I travel to my local past given that time travel is hard for me. So you know that if I attempt to scoop Horwich and time travel is hard, than an unlikely outcome occurs. Third, you know that if I do not attempt to scoop Horwich and time travel is not hard, then I do not scoop Horwich and I do not travel to my local past. It is not at all unlikely that I fail to scoop Horwich given that I do not try, but it is not very likely that I do not travel to my local past given that time travel is not hard; it would be much more likely for me to not time travel if time travel were hard. So you know that if I do not attempt to scoop
Horwich and time travel is not hard, then an at least somewhat unlikely outcome occurs. Finally, you know that if I do not attempt to scoop Horwich and time travel is hard, then I do not scoop Horwich and I do not travel to my local past. This outcome is the most likely of the four. Given that I do not attempt to scoop Horwich, it is once again likely that I do not scoop Horwich. Furthermore, it is likely that I do not travel to my local past given that time travel is hard. Overall, then, the most likely outcome occurs on the hypothesis that I do not attempt to scoop Horwich and time travel is hard.

Let’s take stock. Scooping Horwich features three hypotheses on which an unlikely outcome occurs: I either fail to scoop Horwich even though I try or I fail to time travel even though it is not hard. Had you believed any of those three hypotheses prior to finding out that one of (1*)–(4*) is true, you should not have expected that one of (1*)–(4*) is true on the grounds that their disjunction is unlikely to be true. On the fourth hypothesis, the most likely outcome occurs: I do not scoop Horwich because I do not try and I do not time travel because it is hard. Had you believed the fourth hypothesis, you should have been most confident that one of (1*)–(4*) is true, because (4*) was likely to be true. Because you have no other information that favors any hypothesis over the remaining three, you should be most confident in the hypothesis that, had you believed it prior to learning that exactly one of (1*)–(4*) is true, would have made you most confident in that evidence. That is, you should be most confident that I do not attempt to scoop Horwich and that time travel is hard for me. Because you know that if I do not attempt to scoop Horwich and time travel is hard for me, then I do not scoop Horwich and I do not time travel, you should be at least as confident that I do not scoop Horwich and I do not time travel.

Using the same reasoning we applied to Four Roads, we have now arrived at Horwich’s conclusion in the particular case of Scooping Horwich; information about what I will and won’t do if I time travel is evidence that I will not time travel and that time travel is hard for me. Notice, however, that although we conclude both that time travel is at least unlikely for me and that I will not travel to my local past, we did not argue from the fact that time travel is at least unlikely for me to the conclusion that I will not time travel – as we learned when discussing Four Roads that argument would be fallacious because the fact that one of (1*)–(4*) is true is inadmissible. Instead, that one of (1*)–(4*) is true is evidence that I do not attempt to scoop Horwich and that time travel is hard for me and is thereby evidence that I do not time travel (because I do not time travel if I do not attempt to scoop Horwich). Like my reasoning about Four Roads, my reasoning about Scooping Horwich requires inferences from macro-chance to rational degree of belief only in situations in which we have no inadmissible information (i.e., only when we are thinking about what our degree of belief should be prior to learning that one of (1*)–(4*) is true).
3.2. GENERALIZING SCOOPING HORWICH

The Scooping Horwich scenario is, of course, fictionalized. Most potential time travelers will not be motivated to scoop Horwich in the way described by the case. No matter; the reasoning generalizes to any agent for whom there is an attempt that has the following features (relative to that agent):

i The attempt is likely to succeed.
ii The attempt fails.
iii If the agent travels to the local past, then she makes the attempt.
iv If the agent makes the attempt, then she travels to the local past.

Items (i), (ii), and (iii) combine to imply that a particular unlikely event, a failed attempt, occurs if the agent travels to the local past. These three features are essential because if, say, I time travel without attempting to scoop Horwich or scooping Horwich is hard or I succeed in Scooping Horwich, then we have no evidence that I will not travel to my local past. Item (iv) implies that the unlikely event does not happen if the agent does not travel to the local past. The fourth feature is essential because if, say, I improbably fail to scoop Horwich regardless of whether I travel to the local past, then we (once again) have no evidence that I will not travel to the local past. The reasoning we used about Scooping Horwich, then, generalizes to all agents for whom there is an attempt that satisfies (i)–(iv).

Are there actually attempts that satisfy (i)–(iv) for most agents? Suppose that most of us, if given an opportunity to travel to the local past, will form a strong intention to change some particular aspect of that past. Some of us might not follow through on our strong intentions, but it is plausible that most of us will by attempting to bring about whatever event it is that each wishes had occurred (i.e., it is plausible that some attempt satisfies (iii) for most people). Some of those attempts might succeed because we falsely believe that the past did not go as we wished, but our beliefs about aspects of the past that we wish to change are accurate enough that it is plausible that most of these attempts will fail (i.e., it is plausible that the attempt that satisfies (iii) also satisfies (ii) for most people). Of the attempts that fail, some might have been attempts that were likely to fail because we might attempt to bring about events that are difficult to bring about. However, because time travel allows us to show up well informed and well prepared, it is plausible that most of these failed attempts were likely to succeed (i.e., it is plausible that the attempt that satisfies (iii) and (ii) also satisfies (i) for most people). Finally, because we intend to change some particular aspect of the past, it is plausible that most of us will not make the attempt if we do not travel to our local past (i.e., it is plausible that the attempt that satisfies (iii), (ii), and (i) also satisfies (iv) for most people). For example, I am not even tempted to try to scoop Horwich by submitting a copy of *Asymmetries*.
in Time under my name now. So, on the supposition that most people with access to time travel will intend to change the past, it is plausible that some attempt satisfies (i)–(iv) for most people.

We have now arrived at Horwich’s original verdict about time travel; the fact that most people with access to time travel will intend to change the past gives us reason to believe that most people will not travel to the past and that time travel is hard for most people but without tipping us off as to what it is that prevents most people from time traveling.

4. Objections

I now consider four objections to my Horwich-style argument, the first three of which are inspired by popular reasons for rejecting Horwich’s original argument and the fourth of which is specific to my version of Horwich’s argument.

4.1. FOR MOST PEOPLE, IS THERE AN ATTEMPT THAT SATISFIES (I)–(IV)?

The first objection I consider is targeted at the idea that, for most people, there is some attempt that satisfies (i)–(iv). Smith (1997) provides one instance of this sort of objection:

My reply will to be to point out that backward time travel, in itself, does not entail … coincidences. Rather, each argument which purports to derive such coincidences as output, given backward time travel as input, also uses as input – in addition to backward time travel itself – occurrences which are themselves as rare and apparently improbable as long strings of [coincidences] … if we are confining ourselves to the actual world – in which, we are supposing events in as scarce supply as [coincidences] will continue to occur only rarely – then the arguments in question cannot get started; while if we instead suppose that we live in a world in which there is no reason to expect that the kinds of input coincidence in question will not occur often, then we ipso facto suppose that we live in a world in which there is no reason to expect that [coincidences] will not occur often … in short, the only worlds in which backward time travel and large numbers of [coincidences] occur are worlds in which such [coincidences] cannot be deemed improbable. For the sake of brevity, when I wish to make this point in the future I will write simply ‘improbable outputs can be derived only on the assumption that equally improbable inputs occur.’ (Smith, 1997, p. 381)

Before responding to the substance of Smith’s objection, let me clarify what I take to be its force. First, Smith is entirely correct that neither Horwich’s original argument nor my own revised version shows that time travel alone entails unlikely strings of coincidences – but that is not what the arguments are intended to show. Instead, both arguments use an empirical assumption about what potential time travelers will be like as evidence that time travel is unlikely; in my case, the empirical assumption is that, for most people, there is some attempt that satisfies (i)–(iv). Smith’s objection
is not that Horwich-style arguments require such additional assumptions but rather that those additional assumptions are unlikely to be true.

Second, when Smith writes, ‘the only worlds in which backward time travel and large numbers of [coincidences] occur are worlds in which such [coincidences] cannot be deemed improbable’, he means to restrict our attention to worlds in which the empirical assumption required by Horwich-style arguments is unlikely to be true. His point is that, because the empirical assumption is unlikely to be true (and given that we have no inadmissible information), we should expect that the empirical assumption is false and that Horwich-style arguments are unsound. The only alternative – again, given that the empirical assumption is unlikely to be true – is that we persist in making the assumption despite the fact that it is unlikely to be true. But if it is permissible to expect that unlikely empirical assumptions are true, it is also permissible to expect that unlikely events such as time travelers failing to complete simple tasks will occur. Fair enough, but note that nothing in Smith’s argument should make us doubt that there are possible worlds in which it is likely that there are attempts that satisfy (i)–(iv) for most people; Smith’s claim is merely that no such worlds are actual.

Finally, when Smith sloganizes his objection as ‘improbable outputs can be derived only on the assumption that equally improbable inputs occur’, he does not mean that Horwich-style arguments require an assumption with the content that some improbable outcome occurs. For example, my Horwich-style argument supposes that, for most people, there is some attempt that satisfies (i)–(iv), but the macro-chance that there are such attempts plays no role in my argument except by way of mediating our confidence that the supposition is true. Instead, Smith means that Horwich-style arguments make assumptions that, he claims, are unlikely to be true.

So the question raised by Smith’s objection is simply: how likely is it that, for most people, there is an attempt that satisfies (i)–(iv)? Smith considers a variety of reasons why there might be an attempt that satisfies (i)–(iv) for a person and deems them all unlikely. For example, Smith conjectures that most people with access to time travel (like most people in general) will be clear enough thinkers to reason out that changing the past is impossible and so will not form the strong intention to change the past (Smith, 1998, p. 157). As for myself, I am not as confident as is Smith that confused thinking on the part of time travelers is improbable. Safely confined as I am to the present, it is easy for me to be certain that I will fail to change the past if I try. But if I actually found myself in 1986, sitting in a publisher’s office with a duplicate of Asymmetries in Time in my hand, I doubt that I could stay so certain. Sure, contradictions are false, and I will not change the past … but the publisher is right there and if I just sign my name to this plagiarized copy and hand it to her … what could go wrong?

At any rate, the question of what potential time travelers will (or will not) believe and intend is an empirical question into which I have no
special insight. What interests me about the question is that, assuming that potential time travelers have psychologies relevantly similar to our own, we can find out the answer. And if it turns out, as Horwich claims and Smith denies, that potential time travelers will (if given access to time travel) form the strong intention to change the past, then we have reason to believe that, for most people, there is some attempt that satisfies (i)–(iv), and so we have evidence that most people will not time travel because time travel is hard for them. In other words, the important moral of Horwich-style reasoning is that one potential strategy for gaining evidence about whether time travel is unlikely is by investigating what potential time travelers will (or will not) believe and intend, whether or not the empirical facts actually allow for this strategy to yield interesting results. (Compare: the paradox of the ravens is not dissolved by the observation that not all ravens are black.) That the psychologies of potential time travelers could be evidence about the likelihood of time travel is a philosophically interesting and surprising result that stands even if Smith is correct that it is unlikely for there to be attempts that satisfy (i)–(iv) for most people.

### 4.2. FAILED BILKING ATTEMPTS ARE NOT UNLIKELY

Jennan Ismael, in criticizing Horwich’s original argument, points out that failed bilking attempts – described as such – are not unlikely. She writes

> It is almost irresistible to suppose … that there is something anomalous in the [repeated failed bilking attempts] considered collectively … But that is not right either; there is nothing ad hoc or mysterious coincidental in the scenario … for we never succeed in ordinary cases … in which we fail, either. And it is built into the description of [bilking attempts] that they are failures … there are diverse and unrelated explanations of … individual failures, but nothing spooky or coincidental about the fact that all flounder. (Ismael, p. 308)

A bilking attempt, recall, is an attempt to bring about an event that does not occur. Ismael’s point is that it is guaranteed, rather than unlikely, that an attempt to bring about an event that does not occur will fail. Horwich sometimes seems to miss this point, as when he writes, ‘… we have good reason to believe that the persistent failure of bilking attempts is highly improbable’ (Horwich, p. 122). The persistent failure of bilking attempts, describe as such, is certainly not improbable. Inspired by Ismael, one might object that my Horwich-style reasoning about Scooping Horwich makes the same mistake. After all, I claimed that it is unlikely that I do not scoop Horwich given that I attempt to scoop Horwich, but my attempt to scoop Horwich is an attempt by a time traveler to do something that is not, in fact, done. So, one might argue, it is guaranteed (rather than unlikely) that I do not scoop Horwich given that I attempt to scoop Horwich.
The objection is unfounded. The relevant issue is not whether it is unlikely that I fail to scoop Horwich given that I bilking-attempt to scoop him but is instead whether it is unlikely that I fail to scoop Horwich given that I attempt to scoop him. Perhaps this response will seem like cheating, because my attempt to scoop Horwich is a bilking attempt. To see that it is not, recall that my reasoning about Four Roads assumed that it is unlikely that I make it to the end given that the road is guarded. However, because I make it to the end of the road if it is guarded, every guard fails to stop me. Call guards who fail, ‘failed guards’. The analogous criticism to my reasoning about Four Roads is that it is guaranteed (rather than unlikely) that I make it to the end of a guarded road because it is guaranteed that I make it to the end of a road that is guarded by failed guards. Clearly, this criticism is off track; we cannot properly evaluate how unlikely (or likely) is an outcome by holding fixed whether that outcome occurs. No failed attempt seems unlikely relative to a description that includes its failure, but clearly, some failed attempts are unlikely—among them are a guard’s failed attempt to stop me from making it to the end of a road and my failed attempt to scoop Horwich. Ismael is right to point out that Horwich should not frame his argument in terms of the improbability of failed bilking attempts, but my reasoning about Scooping Horwich does not make that mistake.

4.3. FREQUENCIES VERSUS MACRO-CHANCES

As we saw in Section 3, Horwich’s original argument relies on an inference from the fact that we have not observed correlations between attempts and events that thwart those attempts to the conclusion that we should not expect to see such correlations in the future. Smith (1997) criticizes this move by pointing out that we should not infer from the (mere) fact that we, who have not yet been visited by time travelers, have not observed a particular correlation to the conclusion that we will continue to not observe that correlation in the future (unless we have some independent reason for doubting that we will be visited by time travelers in the future.) Dowe (2003) agrees (as do others, e.g., Sider, 2002) and gives this nice summary of Smith’s objection:

If time travel to the local past were common, then such correlations wouldn’t be improbable, they would be a common feature of the world… We have good reason to think that there are no visitors from the future among us at the moment. The question is, should that fact alone make us think that they will not be coming? No, if such visitors should begin to arrive, it is reasonable to think that we might see kinds of effects that we are not accustomed to seeing. (Dowe, p. 581)

Smith and Dowe are right to criticize Horwich’s original reasoning. By Horwich’s own lights, the regularities we should expect to see if we are visited by time travelers are very different from the regularities we have so far
observed. So we should not expect that the regularities we currently observe will hold in the future unless we have some reason to expect that we will not be visited by time travelers in the future.

However, my version of Horwich’s argument does not make this mistake. I claim that we should not expect that I fail to scoop Horwich if I try. What justifies this claim? One answer might be that, because the observed frequency of failed scooping attempts has been low, we should not expect to see many such future failures. But that answer, as we learned from Smith, is no good; we should not expect that the frequency of failed scooping attempts will remain low once time travel becomes frequent. Instead, I argued that we should not expect that I fail to scoop Horwich on the grounds that my failure to scoop Horwich is unlikely. This answer is importantly different from the answer criticized by Smith because the frequency with which an outcome occurs can diverge dramatically from that outcome’s macro-chance of occurring. Just as a fair coin can land heads 10,000 times in a row but very likely will not, so too a time traveler can fail to scoop Horwich 10,000 times in a row but very likely will not. The fact that the frequency of failure will be much higher if there are time travelers to the local past who repeatedly attempt to change it does not imply that the macro-chance of those failures will be different from the macro-chance of failure for non-time travelers.

Of course, we can imagine scenarios in which the macro-chance of failure for time travelers is not the same as is the macro-chance of failure for non-time travelers. My conclusion about Scooping Horwich generalizes to most agents only if their attempts are likely to succeed, but it is easy to imagine cases in which those attempts are likely to fail. If, for example, time traveling cops doggedly tail time travelers and thwart their attempts, then those attempts are likely to fail and so do not satisfy (i)–(iv). However, the mere fact that I am a time traveler does not imply that my attempt to scoop Horwich is any more or less likely to succeed than is the same attempt made by a relevantly similar non-time traveler. To be sure, something interferes with my attempt to scoop Horwich. Perhaps the publisher misplaces my submission, perhaps I misaddress the envelope, or perhaps the manuscript gets lost in the mail. These factors, however, interfere with the scooping attempts of time travelers and non-time travelers alike; there is nothing about the mere fact of being a time traveler that makes one particularly likely to suffer such mishaps.

4.4. THE METAPHYSICS OF CHANCE

Or maybe not. John Roberts has suggested to me that the macro-chance of failure in cases such as Scooping Horwich is, contra Horwich-style reasoning, 1. His worry begins with the observation that the values of macro-chances evolve over time. For example, it has become less likely that I will
develop osteoporosis because I have been taking these vitamin supplements, and it has become more likely that I will be the next Powerball winner because the first two numbers drawn matched my ticket. One influential theory (found in Lewis, 1986) about how the values of chances evolve over time is that the chance of an event at a time is equal to the chance of that event conditional on the history of the world up to that time in conjunction with the complete theory of chance for that world. Now, that theory will not do as an account of how macro-chance evolves over time. As we saw in Section 2, there are non-extremal macro-chances even in worlds that are fundamentally deterministic, but if a world is fundamentally deterministic, then the chance of an outcome conditional on the complete history and theory of chance for that world must be either 0 or 1. One way to accommodate macro-chances is to amend the theory so that macro-chances evolve not by conditionalizing on the entire history of the world, but on only the macro-history of the world (i.e., the history of the world that can be described in the relevant non-fundamental vocabulary). Unfortunately, this theory of how macro-chances evolve creates problems for my claim that I am unlikely to fail in my attempt to scoop Horwich.

Suppose I have arrived in 1986 and have just attempted to scoop Horwich by dropping my copy of *Asymmetries in Time* in the mail. The chance now that my attempt will succeed, we are supposing, is the chance that my attempt will succeed conditional on (among other things) the macro-history of the world up to now. The macro-history of the world up to now includes my history up to now, but how should we understand ‘my history’? I am a time traveler who came from the future, and so in one sense, my history includes the fact that, in 2017, I came up with the idea to scoop Horwich while reading his published book *Asymmetries in Time*. If my history includes the fact that Horwich published *Asymmetries in Time*, however, then the macro-chance that my attempt to scoop Horwich will fail is 1. We might instead say that my history includes no events that are chronologically subsequent to my attempt to scoop Horwich. In that case, the back end of my history terminates with the fact that I instantaneously popped into existence in 1986. Now, however, my claim that the macro-chance of failure for time travelers is the same as is the macro-chance for non-time travelers might look more dubious. Because the histories of time travelers are so radically different from the histories of non-time travelers, the analogue of Smith’s criticism that I dismissed in the previous section now starts to seem compelling: what reason do we have for thinking that the chance of failure for people with histories like ours is anything like the chance of failure for people who mysteriously pop into existence *ex-nihilo*?

The metaphysics of chance in general (let alone macro-chance) is already vexing, and adding time travel to the mix only makes things worse. Note first that the issue Roberts raises is specific neither to cases in which an agent attempts to do something that, in fact, is not done nor to cases involving
macro-chance (as opposed to micro-chance). His worry is a general one that applies to any indeterministic process whereby the outcome of that process is itself a cause of that process. In non-time travel contexts, we never risk trivializing the chance of an outcome by conditionalizing on a cause of that outcome because no event is both a cause and an effect of a chance outcome. In contrast, my evolving macro-chance of successfully Scooping Horwich will be trivialized by all sorts of factors that are both causally upstream and downstream from my attempt to scoop Horwich; having read *Asymmetries in Time*, for example, is both a cause of my attempting to plagiarize Horwich and an effect of that attempt’s failure, and my chance of Scooping Horwich conditional on having read *Asymmetries in Time* is 0. The challenge is to develop and defend a theory of chance that accommodates indeterministic causal loops.

I won’t offer such a theory of chance here and so, in that sense, my defense of Horwich-style reasoning is incomplete. Nevertheless, we should be suspicious of any metaphysics that rules out the possibility of otherwise familiar indeterministic processes occurring along causal loops. Following Lewis (1976), many philosophers have agreed that there is a sense of ‘can’ associated with ordinary standards of ability on which time travelers can do anything that relevantly similar non-time travelers can do. Suppose a non-time traveler breaks into Horwich’s house in 1986 and steals a draft of *Asymmetries in Time*. Why think that the non-time traveler can scoop Horwich, but that I (who have come from the future) cannot? We both have a copy of Horwich’s manuscript, we both know how to submit manuscripts for publication, we are both determined, and we will both (given that Horwich publishes *Asymmetries in Time*) ultimately fail. It is hard to see how having come from the future impedes one’s ability to, for example, correctly address an envelope or put correct postage on a package. These same considerations also suggest that the non-time traveler’s macro-chance of Scooping Horwich is the same as is mine. How could my having come from the future raise or lower my chance of, for example, correctly signing my name to the manuscript, correctly addressing the envelope, or putting the right amount of postage on the package? The factors that determine my chance of success, like the factors that determine my ability to succeed, seem to be exactly the same in my case as in the non-time traveler’s.

Or suppose that a researcher attaches a sample of radioactive material to a Geiger counter and sends both to her local past. Her younger self checks the Geiger readout on its arrival, which reminds her to prepare the sample of radioactive material with a Geiger counter to send to her local past. Does its journey through time somehow transform this typically indeterministic process of radioactive decay into a deterministic one? At the very least, that question should be answered by physics rather than metaphysics. If our metaphysics of chance rules out even the possibility of indeterministic causal loops, so much the worse, I think, for our metaphysics of chance. While I
readily admit that more needs to be said about how chances evolve in time travel contexts, I take it to be a desideratum for any such theory that it allows for indeterministic processes to occur along causal loops and so can be used to underwrite Horwich-style arguments.15

5. A strange epistemic position

I have argued that Horwich-style reasoning is correct; the proposition that most time travelers will, if given access to time travel, form strong intentions to change the past is evidence that time travel to the past will be rare because it is unlikely. That’s a strange result, because it implies that we can learn that time travel is unlikely without knowing why, by learning what potential time travelers will (or will not) believe and intend. Comparing Horwich-style reasoning with our reasoning about Four Roads allows us to locate the source of that strangeness.

There are two ways by which we come to acquire evidence about the chance of an event. The first way is through learning about facts that are (metaphysically or causally) responsible for that chance value. For example, one way to gain evidence that a coin is fair is by learning that it is evenly weighted, and one way to gain evidence that it is likely to rain is by learning that storm clouds are approaching. The second way is through learning whether the event occurs. For example, one way to gain evidence that a coin is fair is by learning that it has landed heads roughly half the times it has been flipped, and one way to gain evidence that is was likely to rain is to get rained on. Typically, if an event has not yet occurred, then we are only able to acquire evidence about the chance of that event in the first way. Once an event occurs, however, both ways are available to us.

The reasoning I advocated about Four Roads is neither surprising nor strange because it is a familiar instance of the second way of getting evidence about an event’s chance. Horwich-style reasoning about Scooping Horwich is also a case of the second way of getting evidence about the chance of an event, except that it puts us in the very unfamiliar position of being able to use that second way before the event occurs. If we learn that future potential time travelers will, if given access to time travel, form strong intentions to change the past, then we are in a position to know that most of their attempts will fail before those failures occur. Because these failures are unlikely, we expect that the attempts will not be made and so expect that there will not be frequent time travel to the local past because time travel to the local past is unlikely. That we can learn anything about whether our world is conducive to time travel by studying the psychologies of potential time travelers feels strange to us because it is strange; typically, we can only gain evidence about the chance of an event by learning facts that are (at least partly) responsible for that chance. If, as I’ve argued, Horwich-style reasoning is
correct, then we can be in the very strange epistemic position of gaining evidence about the chance of an event without having any information that explains why that chance obtains and before that event occurs. That there are such surprising evidential relationships between the psychologies of potential time travelers and the likelihood of time travel is, to my mind, the most important upshot of Horwich-style arguments.

Department of Philosophy
University of California, Los Angeles

NOTES

1 My profound thanks to John Roberts. Thanks also to Carolyn Brighouse, David Friedell, Jennan Ismael, Theodore Sider, and a very lively audience at Occidental College.

2 Several authors (e.g., Meiland, 1974, Goddu, 2003, Van Inwagen, 2009) have offered multidimensional models of time travel according to which, each argues, it is possible to change the past. If these authors are correct, Horwich’s conclusion is only that a certain sort of time travel will be rare: travel along a single temporal dimension. For ease of discussion, I use ‘time travel’ to refer exclusively to travel along a single temporal dimension – nothing that follows is meant to apply to time travel across more than one temporal dimension.

3 Because Horwich thinks we have independent reason to believe that space–time allows for time travel to the local past but that the fuel costs associated with such travel do not, Horwich identifies prohibitively steep fuel costs as the fact that systematically prevents us from traveling to our local past (Horwich, p. 123).

4 We might, for example, discover that time travel to the local past is physically impossible. In that case, Horwich’s argument tells us nothing of interest about the probability of time travel, but the question of whether Horwich’s reasoning is sound remains of philosophical interest.

5 The assumption that you are equally confident in both hypotheses allows us to keep the math easy and the case uncluttered but isn’t strictly necessary provided that we flesh out other features of the case, such as the precise probability of each outcome, accordingly.

6 Notice that this conditional and the others like it are not subjunctive. The witness informs you that, as it happens, I made it to the end if I faced a hospitable and guarded road. Were I to face a hospitable and guarded road, however, I would probably not make it to the end.

7 The degree to which the fact that one of (1)–(4) is true confirms the hypothesis that the road was inhospitable and unguarded depends on factors that I have left unspecified for the sake of simplicity and generality, such as precisely how unlikely it is for me to evade armed guards or to successfully traverse dangerous terrain.

8 My reasoning about Four Roads (and later about time travel) does not require that macro-chances and micro-chances are of the same ontological kind. For examples of accounts of the metaphysics of macro-chance that would suit my purposes, see Loewer (2001) and (2004), Hoefer (2007), and Sober (2010).

9 In Section 4.4, however, I address the importantly distinct question of whether there can be any non-extremal (macro or micro) chances in time travel contexts.

10 Ideally, one would like a principle that precisely states under which conditions an agent’s degree of confidence should be guided by her beliefs about macro-chances. The most famous nearby principle is David Lewis’s Principal Principle, but the Principal Principle, as traditionally understood, does not recognize macro-chance. Nevertheless, like Loewer (2001) and Hoefer (2007), I am confident that either the Principal Principle properly understood or some suitable variant of it holds for macro-chance.

© 2018 The Author
Pacific Philosophical Quarterly © 2018 University of Southern California and John Wiley & Sons Ltd.
As with Four Roads, these conditionals are importantly not subjunctive.

As with Four Roads, the degree of confirmation depends on details I have left unspecified for the sake of clarity and generality.

A theory of chance for a world is a conjunction of true history-to-chance conditionals that specify the chance value of future occurrences for every possible history of that world.

Having said that, here is one reason to doubt that there can be non-extremal chances in Horwich-style scenarios: if there are such chances, then we can get evidence about whether there will be time travel by learning about the psychologies of potential time travelers. Fair enough—perhaps the consequent of that conditional is more absurd than is the denial of the antecedent but that is nevertheless an interesting philosophical result derived from Horwich-style reasoning.

REFERENCES


Godd, G. C. (2003). ‘Time Travel and Changing the Past: (or How to Kill Yourself and Live to Tell the Tale),’ Ratio 16(1), pp. 16–32.


