

Branching histories approach to indeterminism and free will

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My plan is to use the broadest of brushes to describe rigorous but low key notions of indeterminism and free will as they occur in some recent work based on the idea of “branching histories.”¹ It is of course not so obvious in advance at just which target we are aiming, although below we report some contributions by baseball’s Yogi Berra that help clarify our hopes. In the meantime, although it will hardly be surprising if you find yourself harboring definite reservations and uncertainties, I hope the meaning of our ideas will become moderately clear.

1 Introduction

Philosophy has always contained separate scientific images and humanistic images (Sellars called them the scientific and manifest images), and many philosophical enterprises can be described as either lying wholly within one image while either ignoring or being contemptuous of the other, or as trying in some sense to reduce one to the other. Our enterprise for the past few years can be seen as an effort to find ways in which the two images fit together, without diminution of either. Our particular strategy is to look for very general quasi-geometrical structures that underlie both images. In this sense our theory could be described as equally proto-scientific and proto-humanistic. The enterprise isn’t itself either

¹Many of the ideas related to agency were first developed by von Kutschera over fifteen years ago (von Kutschera 1986). Since about the same time Paul Bartha, Mitchell Green, John Horty, Michael Perloff, Matthew Weiner, Ming Xu and the author have intermittently worried at different aspects of the topic, often jointly. Recent book-length reports, which include references to papers by the named workers as well as to important books and papers by others, are Horty 2001 and Belnap, Perloff and Xu 2001.

scientific or humanistic, but it does try to provide some ways of thinking that are intended as useful for both.

I am going to begin by describing some features of our general “branching histories” framework. Second, I shall try to give you some of the flavor of how the theory of branching histories applies to the humanistic concepts of action and agency and choice—and free will. Third, I shall say something about how branching histories help us to get a little clearer on how indeterminism ought to work in our scientific views.

2 Branching histories

The “*branching histories*” framework offers a theory of *possibility*, or, much better, *possibilities*.

2.1 Importance of objective possibility

Every philosophy must somehow or other take account of the category of possibilities, a foundation on which many of our most fundamental concepts rest. Here there is a great divide. For some applications one needs only *unreal* possibilities. Perhaps they are given in the mind, as imaginary or fancied alternatives to our actual situation. Or perhaps the possibilities are constructed in some clever way out of concepts or language or social structures such as conversations. For example, in making sense out of fiction or belief or justification or good reasoning, the alternatives one brings into play need only be plausible.

It is the same in science. For many purposes, scientific possibilities need to have only epistemic, which is to say, *mental* status, in someone’s mind, or perhaps *social* status in a family practices. For these limited, chiefly heuristic, purposes, the time-worn phrase, “consistency with the laws,” has some utility as an account of possibility. This remains true even though, as is obvious, “the laws” are just slippery pieces of language, made by man. The point is that for heuristic and practical purposes, there is often no need for anything more.

But for certain concepts, one must insist on—in a phrase of Xu 1997—*possibilities based in reality*. To settle for some kind of “compatibilism” that would combine “scientific” or “objective” determinism with slippery subjective or linguistic notions of possibility is, we think, to lose one’s grip.

Let me list some obvious places in which one needs real (objective) possibilities.

1. There is *no objective probability* without objective possibility. It is easy to neglect this. We teach students to race through the probability calculus without paying attention to what it means. And even though philosophers debate endlessly and fruitlessly about the meaning of probability, this much is plain: If you are unable to give an account of the possible and the impossible, you will never be able to give an account of the probable and the improbable. How could you? In technical terms, it is the real possibilities that provide the so-called probability space that must be found under any objective probability measure. If you don't have possibilities you don't have a probability space; and if you don't have a probability space you certainly cannot have a probability.
2. There is *no action, no doing, no responsibility, no agency*, without possibility. This is a principle theme, and I shall return to it later. There is neither justified hope nor justified fear, neither obligation nor license, neither justified pride nor regret, unless there be possibilities rooted not just in someone's mind, but in reality as well.
3. Perhaps of most significance, there is *no causality* without objective possibilities. This is a second principle theme, and again it is one to which I shall return, although very briefly and without the likelihood, in this brief compass, of much clarity. In the meantime, keep in mind that there are many causal concepts without the word cause. Here are just a few: influencing, interfering, intervening, and experimenting. None of these make real sense unless there are real possibilities.

Since Leibniz, however, much philosophy has either neglected to take real possibilities seriously, or, having taken up the challenge that they present, has declared them null and void. Because many of us participate in the strict-deterministic attitudes engendered by this philosophical history, it is worth pausing a moment in order to ask why. After long preparation by theological meditation on the meanings of Omnipotence and Omniscience, presumably a fresh cause was the marvelous practical success of deterministic mathematical physics. Laplace says that his demon leaves no room for really alternative possibilities. To be consistent with this world-view, Hume says that causality is not objective at all, but instead a habit of mind. Kant, sharing his century's conviction in the absolute accuracy of the deterministic vision, says that there is no possibility beyond actuality, and indeed, that there is no actuality that goes beyond ironclad necessity. In Kant's effort to make sense out of strict determinism, possibility, actuality, and necessity

are *the same thing*. With the spread of lockstep clocks and machines, and with so much genius philosophizing in behalf of strict determinism, it is hardly surprising that many philosophers fail to take seriously the idea of objective possibilities.

Without urging this explanation of why philosophy has tended largely (but certainly not entirely!) to avoid the idea of real possibility, let us pass on to the central ideas of branching histories relevant to the problem of fitting objective possibilities together into a single world. There are some generic ideas about branching histories that come from the idea of possibility itself. And then there are two special cases. The special cases have been called, some what ponderously, “branching time” and “branching space-times”; but we shall have little need for these heavy words.

2.2 How objective possibilities fit together

Let us begin with the more general ideas of branching histories. They are as follows: (1) *Our World* and its possibilities, (2) events, (3) histories, (4) consistency, (5) branching, and (6) causality.

Our world. First and foremost, *Our World*. Metaphysical modal logicians to the contrary, possibility based in reality calls for only one world, yours and mine. Many things belong to *Our World*, certainly many more, as Hamlet teaches, than find themselves in anyone’s dreams. Among the contents of *Our World* are *possible events*. In fact *Our World* is filled with possibilities. These are not, however, ghost creatures of mind or language, nor are they facts about other worlds. Possibilities for you and for me are real possibilities *inside* of *Our World*. Consider the possibility that in two or three minutes you stop reading and start singing. We should reject the advice of many philosophers that, to locate this possibility, we must investigate our own mental or linguistic creations. We must reject the advice of others that we turn our ontological attention to other worlds. The odd but reality-based prospect of you finding yourself singing is rather *for us the worldly, here and now*. Nor, for another example, do we need to look beyond this world for the possibility that some short time ago you *could have* refrained from starting to read these words. Real possibilities are neither inventions nor otherworldly. They are firmly located inside our very own world. This is what needs to be made intelligible. This is the topic of branching histories.

Events. So possible events are part of *Our World*. The sticker is this. It can happen that two events are each individually possible, while at the same time they cannot happen together: Peter may turn left or he may turn right, so each is a real possibility.² But it is impossible that he does both. This is a fundamental fact about how possibilities fit into *Our World*: Each of two events can happen, but it is not possible that both happen. It sounds to the naive ear as if we are saying that at most one of the two events can be part of *Our World*, but that is precisely wrong. What we need to mediate the difficulty is the concept of a “history.”

Histories. A history is a collection of events that *can* all live together with consistency. Past history is certainly like that. Since everything that did happen did happen, there is no doubt that the entire past fits together into a single, consistent story. There is, however, more to the idea of history than the past. Each history (in the sense at issue) stretches also into the future. A history goes all the way back *and* all the way forward. There is not only past history but future history.

Here we come both to the technical heart of the scheme in which we are working, and to a challenging problem in the philosophical analysis of temporal language. On the technical side, each history is seriously maximal. Each history contains every event that it can contain, subject to the consistency requirement. A possible event is excluded from a history if it is not consistent with some portion of that history; but that is the only limit. A history is as big as it can possibly be. (Of course there is a rigorous definition here.) That is why, on this conception, histories stretch into the remote future, long after the heat death of the sun.

On the analytical side, we must keep constantly in mind that serious attention to alternative possibilities implies that there is no *unique* “future history.”³ Instead there are many alternative and inconsistent possibilities.

Consistency. We can now say the following: Two or more possible events are *jointly consistent* exactly when they fit into a single history. The point is that we can say that not as if it were a new thing, an idle thought. Instead, because we

²From now on I shall usually bore you with the most mundane of examples, Peter deciding whether to turn left or to turn right. The point is to prevent the philosophical distraction so easily caused by interesting stories.

³In the language of logic, although the phrases “my left shoe” and “my world” have unique referents determined by the context of utterance (Kaplan), “my future history” does not—simply because an utterance event, like any other event, belongs to many histories each of which represents a distinct unfolding of possibilities. This is spelled out in tedious detail in chapter 6 of Belnap *et al.* 2001.

have taken the trouble to be rigorous, we can say it confidently and use it as a sure guide when thinking about difficult matters such as action or indeterminism.

Branching. What, however, about branching? Here is the idea. Since there are many inconsistent groups of events, there must be many histories. There are the histories in which Peter goes left, each of which must be distinct from each history on which Peter goes right. The question now is, How do these histories fit together? On one all too common answer, each history is a “world” unto itself. According to this answer, histories stand independently, like a row of parallel lines that never, never meet. This answer, championed by David Lewis, is popular, but it must be rejected. It is not an accurate account of our world. Picture Peter facing the future, not having decided whether to turn left or to turn right. Here is the critical point. His momentary indecision certainly belongs to only one world, our world, but with equal certainty it belongs to *more than a single history*. There is the continuation in which Peter goes left, and there is the continuation in which he goes right. As we say idiomatically, there are in this world of ours two things that Peter can do. Going left is a historical possibility and going right is also a historical possibility.

Theory now extracts the following from this picture of Peter at the crossroads.

1. *The past portions of these two histories are identical.* The independent worlds of Lewis’s theory never overlap, whereas in contrast the two histories *literally* overlap. Each of the two histories literally contains Peter’s indecision, and everything that led up to it. A mental or linguistic theory would make these pasts “similar” instead of straightforwardly identical. But that is wrong. We began by contemplating that there were for Peter two possibilities, left and right, just as I have two shoes, say L and R. And just as it is unhelpful to say that L’s owner is only “similar” to R’s owner, but not identical, so it is unhelpful to say that the indecision in the past of Peter’s possible left turn is only “similar,” but not identical, to the indecision lying in the past of Peter’s possible right turn.
2. *The future portions of these histories are entirely separate.* One contains the possible event of Peter’s going left, but excludes the possibility of his going right. The other contains the (equally) possible event of Peter’s going right, while excluding his going left. These portions are not merely dissimilar to each other “under some description,” in the way, perhaps, that Quine’s spy is descriptively dissimilar from Orcutt. They are straight-out, not to say radically, distinct.

3. But although the future portions of these histories are and remain totally inscrutable each to each (no windows opening from the history-portion with the left turn into the history-portion with the right turn), nevertheless, they are connected in an important way: *They share a common past*. The possible event of Peter's going left has in its past Peter's painful indecision; and so does the possible event of Peter's going right. These two inconsistent events have the same past. That is how they fit together into our one and only world. English tenses get the matter exactly right: If we locate ourselves at the event constituting the possibility of a left turn, there and then we may truly say, "Yes, Peter turned left, and a right turn is not *now* a possibility for Peter, but it *was* true that he *could* have turned right.

4. And that is what we mean by "branching histories." Histories and therefore events fit together to form a single world, *Our World*, and *Our World* looks, to an approximation, like a "tree." In the past all is consistent, and looking back from our present prospect, we see a single stem or trunk. As, however, we look towards the future—sometimes called the "open" future—there is a branching into many possibilities, each consistent in itself, but only some combinations of which go together to form a total history. (Let me interrupt to note that later on we shall need to modify the picture. That is the job of branching *space-times*.)

5. This, then, is the branching-history account of how events that are individually possible but jointly impossible can constitute a single, unified world. The central point is that each pair of events, and especially inconsistent events, are mediately connected by means of a past out of which they arise. If a being were to stand off and look at the tree as a whole, it would see no loose or disconnected pieces. Every possible event, no matter how remote, is connected in some way or other to the here-now with which we begin.

Causal relation. The theory of branching histories also gives us a kind of principle of causality. It says—rigorously, with no kidding around—that, in a simple case, if you find yourself in one history instead of another, then you can always look back into the past for a crucial branch point at which the world offered a turn one way rather than another. What happens at that branch point serves as a truly originating or productive cause. We call this the "prior choice" principle.

The prior choice principle says this:

*When we are looking for a token-level cause of some outcome, we may always look to the past.*⁴

This is a true and deeply important feature of *Our World* (we think), but watch out: We do not say that it holds for “epistemic” causes or “linguistic” causes or “scientific” causes, or any other man-made relation. To say that it did would be to make an unreliable generalization about the workings of an unreliable instrument, the human mind. Instead, the prior choice principle concerns only causes based in reality.

2.3 Summary of branching histories

So much for the chief ideas of the theory of branching histories. When worked out, the theory is rigorous and indeed formal. It is a theory about *Our World*, the only one we have. It tells us that there are events that stand in a causal order. It tells us that these events are organized into histories. It tells us that these histories branch, but only forward. It tells us that causal choice points can always be found in the past. Above all, it tells us that the causal order of our world permits alternative possibilities for the future, whereas, in the words of a poet, the past is fixed in stone.

One thing that I cannot make clear with this over-brief word picture of Peter at the crossroads is this: I am alluding to an absolutely rigorous theory, which, though omitted here, is given in detail in the listed references.

3 Agency, choice and unpretentious free will

Having given the chief ideas of branching histories themselves, how is this application applied to action and agency? And how does this application give a low key account of free will? The answers are related. They rest on four principles.

3.1 Four principles concerning agency

First principle about agency in *Our World*. The first principle is a logical principle about language. It is this:

Whenever we can truly describe Peter as the agent in some affair, we can find a particular sentence X such that Peter sees to it that X.

⁴The choice of “may” here over “must” is critical; see note 9.

Example. For Peter to turn left is for Peter to see to it that he turns left.

This is a principle that only a logician could love. It nevertheless turns out to be enormously helpful in thinking about agency. We didn't make it up. In fact, the principle that agency can always be described as a seeing-to-it-that is originally due to St. Anselm, who discovered it nearly nine hundred years ago. To my knowledge the principle was then absolutely and completely forgotten for over eight hundred of those nine hundred years (§1D of Belnap *et al.* 2001 gives a kind of mini-history of the matter). If we live by Anselm's principle, we do not have to think about or worry about or ask unanswerable questions about peculiar ontological entities such as "Peter's turning left," or worse "Peter's turning left either slowly or not at all," or perhaps worst, "Peter's refraining from turning left." With what strange properties should we endow these postulated entities? Anselm's "sees to it that" formula directs us away from such unhelpful ontological inquiries. That is one way in which his principle keeps our metaphysics low key.

Anselm's "sees to it that" idea is simple. This very simplicity, however, gives a solid impetus to further progress by use of the following very general fact about language: New sentences can be built from old sentences. For example, refraining is a difficult concept in the philosophy of action. We can use the Anselm perspective to give a helpful analysis of refraining.

Example. For Anselm to refrain (say) from accepting his episcopal office from the tyrannous King William Rufus is precisely for Anselm to see to it that Anselm does not see to it that Anselm accepts his episcopal office from William Rufus.

That is of course a mouthful, or better, an earful. But after all, the situation is precisely one in which logic helps: It helps us, by providing us a logical notation (not here displayed) that is easy for the *eye* exactly when English gives us complicated and confusing sound-patterns that overburden the *ear*.

Second principle. The second principle is this:

There is no action, no agency, no doing without choice

Furthermore, and when spelled out this is part of the deep theory, the choice must come *before* any outcome that is settled by the choice. You cannot choose to modify the settled past. If we put these ideas together, we come to something like the following major analytical equivalence.

To see to it that X is to make a prior choice that guarantees that X.

Example. Peter has seen to it that he turned left if and only if Peter has made a prior choice that guarantees that he turns left.

Probably it needs explicit mention that we are *not* saying that Peter's choice must precede his *action* of turning left; after all, our Anselm-based "sees to it that" theory says nothing at all about some "action" to be called "Peter's turning left." The second principle concerns only the conditions under which *sentences* are true. It says nothing at all about when actions exist—or whatever it is that actions do. This is yet another way in which our theory is low key.

Third principle. The third principle works together with the others. The third principle has not been urged as often, but seems to us just as obvious and just as critical:

There is no choice without choices.

That is, if the objective situation is such that Peter is truly described as having any real choice at all, then Peter must have open to him more than once choice. Peter cannot really and objectively choose to turn left unless he has another option available to him that does not guarantee his turning left.

How, you may ask, are Peter's objective options organized? Since they are objective, there must be a principle of organization that does not lie entirely in his mind, nor in language, nor even in logic. There must be a level at which we can say how his options are organized in terms of the purely objective theory of branching histories. In these terms, the outcome in which Peter turns left resides (not in a single history but) in a certain *family* of histories. No history in this family can (possibly) contain the outcome in which Peter turns right. In fact the correct picture to have is that Peter's choice constitutes a branch point. And that is exactly what is claimed by our theory of agency.⁵

Fourth principle. There is one additional subtlety. The theory of agency when set against the theory of branching histories gives rise to a new principle, a fourth principle, a principle that has not yet been studied with the care it deserves. The

⁵Only very simple choice situations can be represented in terms of a single branch point. Our research strategy has been to try to clarify the simple case before attacking the more complex ones, some of which we also treat.

reason for this is that the principle cannot even be properly stated without a development of the rigorous theory of branching histories. Nevertheless, I can give you its flavor in a slogan:

You cannot make tomorrow's choices today.

You can plan and plan and plan, but if tomorrow is when you are given the choice whether or not to eat fish for breakfast, then as an objective matter, it is impossible for you to make that choice today. Sometimes we call this fourth principle “*no choice before its time*.” Attention to this principle—first rigorously formulated by von Kutschera and (later but independently) by P. Kremer, only in the mid-eighties(!)—can only enrich moral philosophy and the philosophy of action.

Summary of principles. To summarize: (i) Agency is well codified with “seeing to it that” sentences. (ii) There is no agency without choice. (iii) There is no choice without choices. And (iv) there is no choice before its time.

3.2 Unpretentious free will.

With these four principles I can quickly come to our unpretentious account of free will. There are three key ways in which we keep a claim to “free will” simple and straightforward.

1. In the first place, a serious claim to free will must always mention a particular agent. Our recommended “sees to it that” formula is ideal for this purpose, precisely because one cannot complete the formula without specific reference to an agent.
2. Second, any meaningful claim to free will must make specific reference to a possible outcome. Again, the “sees to it that” formula always requires a specific sentence.

Example. The Bishop won the lottery. Question: Did the Bishop see to it that the Bishop won the lottery? Well, no, it was a matter of chance. No free will for *that* specific outcome. Change the example if you like. Perhaps the Bishop fixed the lottery. Perhaps it is a matter of the Bishop buying a ticket.

In any case, if you do change the example, please notice what you are doing. *Free will does not float free of particular agent or particular outcome.*

3. Last and of critical importance, our account of action and agency in the context of branching histories requires reference to a particular moment or locus of choice.

Let us gingerly approach an example with these three ways in mind.

1. First, we are tempted to ask, Is there any free will, or is the world instead a place of blind adherence to natural law? When we frame the question in this tempting way, we are tempted to respond in its own immodest terms. We know that stars and machines are fixed in their trajectories, and so are tempted to answer that not only stars and machines, but each thing whatsoever, follows out its preordained path. Perhaps, having been tempted by the form of the question, we do not notice that this extremely universal theory is pretentious. We are better off if, to begin with, we ask a much more particular question. Ask instead if Peter has free will. Can Peter ever see to anything? That is much less immodest.

Be specific about the agent. It is a virtue of our “sees to it that” formula that it is never complete without the name of a definite agent, and therefore suggests the humbler question.

2. All right, so let us name the agent. Is, then, Peter, in particular, free, or is he instead a creature of external and impersonal forces? That question is also too general and will tempt you into immodesty. Be specific. The “sees to it that” formula will help you. Do you want to know whether Peter can see to it that he flies to the Moon on gossamer wings? No, he cannot. Or do you ask if Peter can see to it that wins the Irish Sweepstakes? No, he does not have available a choice that guarantees that outcome. Or do you rather wonder whether Peter can see to it that he turns left? Yes, he can.

Be specific about the outcome. It makes a plain difference. For now, according to the major analytical equivalence quoted above, we are asking in a pedestrian fashion whether or not Peter has a choice in the matter of his turning left. And of course he does.⁶

3. All right, let us both name the agent and the possible outcome. Can Peter see to it that he turns left? Or can he do so only if he is in the grip of an

⁶You will have observed that nowhere do we offer positive arguments against immodest determinism. Instead, we turn to thinking about problems, too little considered, that have low-key indeterminism as a presupposition. Perhaps this is a mistake. In any event, that is the spirit in which we say “of course he does.”

appropriate combination of character, desire and belief, a combination that is all by itself causally sufficient to bring about his turning left? Even that is immodest.

Be specific about the moment. Suppose that at a certain moment Peter has available a choice that guarantees his turning left. Then certainly our theory says that *after* that moment he has used up his choice. His turning left is already guaranteed, and Peter cannot undo that choice. He cannot alter the settled past, he cannot make the same choice again. But also remember the principle of “no choice before its time.” Our theory also asserts that no choice can be made before the moment at which it becomes available. (And I remind you that although that sounds like a barren tautology, it is instead a deep principle concerning how choices fit into *Our World*.) So there is for Peter and for his turning left a particular moment of choice. We may turn over the moments before and after to the fierce determinist. But at that very moment, neither sooner nor later, Peter has just a little free will in the matter of his turning left. Moments of choice come and go. *Carpe diem* is too crude. To choose, you must not only seize the day, but you must seize the very moment.

For summary, American philosophy has yielded none better than three famous baseball aphorisms commonly attributed to Yogi Berra.

- Here, first, is Berra’s statement of the principle of no choice before its time:
 - *It’s not over ’til it’s over.*
- Second, Berra’s phrasing of the causal principle and the uniqueness of the past:
 - *When it’s over, it’s over.*
- And last, Berra’s own account of the practical attitude required of an agent making choices in our indeterminist world:
 - *When you come to a crossroads, take it.*

The upshot is that at that very moment of choice, we claim for Peter a portion of unpretentious free will: At the moment of choice, Peter can make a choice guaranteeing that he turns left, and he can also make a choice that goes right. (Some people think this contradicts science. They are mistaken, probably both with respect to freedom and with respect to science.)

4 Branching space-times and modestly local indeterminism

Finally I turn briefly to the problem of modestly *local* indeterminism as a pre-scientific idea. The fact is that histories do not really branch like a tree. Such a picture would work if there were an objective meaning for a simultaneity-slice that ran from one edge of the universe, so to speak, to the other. Such a simultaneity-slice would allow histories to split globally. But we know from Einstein that to think of such simultaneity-slices as objective is corrupt. We need another picture.

The new picture comes from the following observation. Individual histories are not really ordered like a line. Our modern reverence for classical mechanics and our related love of clock time deludes us. Not only fancy Einstein physics, but even our ordinary experience (when uncorrupted by uncritical adherence to Newton or mechanical addiction to clocks and watches) shows us that events are not strung out one after the other. Take the event of our being here now. Indeed some events lie in our future—or, better, keeping possibilities firmly in mind, we should say that some events lie in our future of possibilities. Others lie in our causal past. But there is a third category, always intuitive, and now scientifically respectable, since we have learned in this century to be suspicious of the idea of *action at a distance*. In this third category are events that neither lie ahead of us as possibilities, nor do they lie behind us as determinate facts. Instead, they have a space-like relation to us. Neither later nor earlier (nor frozen into simultaneity by a mythical world-spanning clock), they are “over there.”

The jargon word for this structure of events is well known: It is called a space-time. So each history, each possible course of events, is a space-time. It needs zero training in mathematics to see that the theory of how such histories fit together into a single world will be more complicated than the theory that we pictured with a single tree. I mention only four key points underlying the theory of “branching space-times.”⁷

1. Here is the first point. You will remember that histories are closely related to the ideas of possibility and consistency. A key idea here is that what allows two events to share a history, and therefore to be consistent, is that at least one event lies in their common future. As long as there is a standpoint

⁷The theory of branching space-times is discussed in the following places: Belnap 1992, Szabo and Belnap 1996, Rakić 1997, Belnap 1999, Placek 2000a, Placek 2000b, Belnap 2002, Müller 2002, and Placek 2002.

in *Our World* from which one could truly say “both of these events have happened,” even if the two events are not themselves arranged one after the other, one may be confident that the two events can live together in single history. Peter’s (possible) going to the dentist in one village and Paul’s (possible) staying home in another village are consistent just in case there is some (possible) standpoint at which someone could truly say, using the past tense, that both events came to pass. Let us also turn this around: If two events are *inconsistent*, then no event can have both of them in its past. For example, although Peter’s choice to turn left or right is altogether local, and although we cannot picture *Our World* as a tree, nevertheless, there is no standpoint anywhere in *Our World* that has in its *past* both of the inconsistent events represented by Peter’s having turned left and his having turned right. These inconsistent possibilities can and must lie ahead of the point at which he makes the choice, but they cannot both lie behind anything whatsoever.

2. The second point is this. There have to be choice points, definite local events at which two histories split into radically inconsistent portions. It is presumably not true and we must not assume that when splitting occurs, it occurs in some magical worldwide way. When Peter is given the choice to go left or right on a certain occasion, that occasion is confined in space as well as in time. His little bit of free will is local, not global. And the same might be true when the choice is only metaphorical, a matter of a random outcome of some natural event such as, perhaps, the decay of a radium atom in Paris. It might be that the decay is a strictly local matter, neither influencing nor influenced by contemporary happenings in, say, Manhattan. Whenever there is indeterminism, whether of choice or of chance, a good theory must give meaning to the difficult idea that the indeterminism is local, not worldwide.
3. The third point is critical to understanding *Our World*. When I put the point in everyday language, it sounds so obvious that you will yawn. And yet as far as I know a thoroughly controlled statement has never been made apart from the present theory of branching space-times. The key postulate for locating choice points may be put informally in the following way: Whenever we find ourselves in one history instead of in another, we may always *look to the past* for a choice point responsible for the splitting.

Example. Suppose that on a certain Friday in March a cat is sleeping on its mat in a certain living room in Chicago. Think of this as

a particular concrete event, and let it be contingent. Take any history in which that event fails to occur, perhaps a history in which the cat spends the whole of the Friday high in a tree in Lincoln park. The theory guarantees that if you look in the causal past of the given concrete cat-on-the-mat event (the one that we are supposing occurred), you will find a definite choice point at which things could have gone either in the direction of keeping the cat-on-the-mat event possible, or in the direction of keeping the cat-in-the-tree history possible.⁸ You do not need to look in the future, and you also do not need to look far away at events going on “over there.” The point is that examination of the causal past of the cat-on-mat event suffices. (The theory does not presume to say if the choice was up to the cat, or up to some human, or perhaps a bit of natural randomness or some combination.)

The fourth point records a recognition of an important way in which the theory should *not* be strengthened. The following is a principle that an unwary philosopher might easily be inclined to endorse.

Tempting principle. If two choice points are related in a “space-like” way, so that the second is “over there” with respect to the first, then their respective choices are entirely independent of each other.⁹

Example. Aristotle tells us how two market-goers meet at the market, as an “accidental” result of their choices that morning, made separately in far-away villages. Their individual choices, we all suppose, are bound to be totally uncorrelated, that is, independent, and that is what the tempting principle says *must* be so.

The theory of branching histories, however, resists this temptation. And it does not do so *a priori*. It does so because *Our World* seems, as a matter of fact, to contain violations of the tempting principle. With reference once more to Einstein, modern physics seems to tell us that in fact it is possible for two utterly random choice points to be space-like related, with no hint of a line of causal connection between them, and nevertheless fail to

⁸The theory will not let you exchange “event” and “history” here; precision of statement is essential.

⁹In Belnap 2002 this principle is suitably generalized and shown to be provably equivalent to an equally tempting principle saying something like “*every* situation that is cause-like with respect to a certain outcome event lies in the past of that event.”

be independent. I call this “funny business.” Reichenbach has taught us that whenever we find the long arm of coincidence stretching across space, it is in our nature to look for a common cause. Funny business precisely happens when there is objective coincidence—which is to say, a failure of independence—across space, without a common cause. Since modern-day physics tells us that funny business happens, it is good that the theory of branching histories has room for funny business—and indeed has the virtue of permitting us to offer a stable (albeit conjectural) account as to the difference between (1) mere indeterminism without funny business and (2) indeterminism with funny business.

These necessarily too-brief points allude to a theory of branching histories that gives a satisfying account of how physical indeterminism can be local instead of global. It gives us an account of how choices and outcomes of natural random processes can affect only what lies in their causal future, touching neither their past nor the vast region of space-like related events. But it does so in such a way as to allow plenty of room for individually random processes to be, as the physicists say, “entangled.” Or, in the phrase I just used, the theory of branching histories helps us to come to terms with funny business.

The result is that the theory of branching histories, in addition to helping us clarify ideas of action and agency, provides low key suggestions for articulating some of the strangest phenomena uncovered by contemporary physicists. It does this by avoiding careless or fuzzy or sloppy formulations. It does this by insisting on a careful and rigorous account of what it is for indeterminism to be not immodestly global, but modestly local.

5 Wrap up

So much for branching histories. So much for the application to action, agency, and choice. So much for the application to physical indeterminism, and especially to funny business.

In closing I should like to emphasize one critical feature of our point of view. It is this: For indeterminism and free will, we need to consider just one world. This world, *Our World*, is big and complicated enough to contain everything, both agents and atoms, both choices and chances, and of course much else. The objective causal order binds all together, without benefit of “laws” or other products of the imagination. And *Our World*, yours and mine, is especially rich in possibilities for our future.

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