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Open future and modal anti-realism

Daniel Kodaj

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Abstract Open future is incompatible with realism about possible worlds. Since realistically conceived (concrete or abstract) possible worlds are maximal in the sense that they contain/represent the full history of a possible spacetime, past and future included, if such a world is actual now, the future is fully settled now, which rules out openness. The kind of metaphysical indeterminacy required for open future is incompatible with the kind of maximality which is built into the concept of possible worlds. The paper discusses various modal realist responses and argues that they provide ersatz openness only, or they lead to incoherence, or they render the resulting theory inadequate as a theory of modality. The paper also considers various accounts of the open future, including rejection of bivalence, supervaluationism, and the 'thin red line' view (TRL), and claims that a version of (TRL) can avoid the incompatibility problem, but only at the cost of deflating the notion of openness.

Keywords Anti-realism · Bivalence · Future contingents · Indeterminism · Modal abstractionism · Modal realism · Ontic vagueness · Open future · Supervaluationism · Thin red line · True future

According to a venerable philosophical intuition, the future is open. Not everyone shares this intuition, of course. Determinists notoriously don't: they think the future is fixed. Neither do necessitarians: they think the future is *necessarily* fixed. But many philosophers (and, arguably, most of the folk) believe that the facts of tomorrow are not fully determinate and many details of the future are unsettled as of now. I'll call this "the open future intuition."

D. Kodaj (✉)
Central European University, Budapest, Hungary
e-mail: kodaj_daniel@student.ceu.hu

In the following, I argue that the open future intuition is incompatible with realist theories of possible worlds. By "realist theories of possible worlds," I mean theories that involve an ontological commitment to mind-independent possible worlds. In this sense, Lewis's 'genuine modal realism' is not the only realist game in town; its arch-rival, modal abstractionism, is equally realist.

I assume that these two (types of) theories exhaust the modal realist options, and I assume that if openness is shown to be incompatible with modal abstractionism as well as with Lewis's modal pluriverse, then openness is shown to be in conflict with realism about possible worlds in general.

In Sects. 1 and 2, I give a preliminary definition of the open future and I compare it to rival conceptions, some of which, I'll claim, fail to capture the crucial intuition behind openness. Section 3 gives the canonical definition of openness, which is neutral between my original formulation and those rivals that seem equally adequate. The argument itself is laid out in Sects. 4 and 5, where I show that neither modal abstractionism nor Lewis's modal pluriverse can accommodate openness. I claim that Lewis's pluriverse rules out openness *tout court*, while abstractionism can be reconciled with openness only by making the abstractionist ontology either incoherent or modally impoverished. Finally, I examine a version of the so-called 'thin red line' view, which, I'll argue, can escape the problems discussed here, but only at the cost of deflating the notion of openness. The paper concludes that those who prefer a strong conception of the open future should believe in intraworld powers or dispositions to ground possibility, or they should be eliminativists, fictionalists or Quinean skeptics about modality.

1 What is openness?

Like many important themes in metaphysics, the idea of open future rests on a powerful intuition. Here's how David Lewis describes the intuition in question:

> Consider […] the obscure contrast we draw between the "open future" and the "fixed past." We tend to regard the future as a multitude of alternative possibilities, a "garden of forking paths" in Borges' phrase, whereas we regard the past as a unique, settled, immutable actuality. These descriptions scarcely wear their meaning on their sleeves, yet do seem to capture some genuine and important difference between past and future. What can it be? (Lewis 1979, p. 459)

Lewis surveys five possible answers: (i) the future is epistemically less accessible, (ii) the future contains rival timelines (all but one of which disappear as we go along), (iii) the future is nomologically underdetermined, (iv) the future is 'mutable,' (v) the future counterfactually depends on the past, but the past doesn't depend counterfactually on the future. This motley of analytic options shows that the idea of openness rests on a very rich intuition indeed, one linked to such diverse concepts as epistemic access, lawhood, counterfactuals, branching timelines, and freedom. How one defines openness crucially depends on which of these concepts are emphasized.

In the following, I shall be concerned with metaphysical, as opposed to epistemic, openness, only. Clearly, the latter is a weaker condition on the future: epistemic openness means that we don't *know* what will happen, whereas metaphysical openness means that it is not yet *settled* what will happen. Metaphysical openness entails epistemic openness, but not vice versa.

Here's a first-pass attempt at a definition (to be slightly revised later, see fn. 11): If P_1 and P_2 are propositions about rival future possibilities (e.g. P_1 = "It will rain tomorrow", P_2 = "It won't rain tomorrow"), then the future is metaphysically open today iff $P_1 \vee P_2$ is true today, but neither P_1 nor P_2 is true today, because their truth-values will only be settled tomorrow. More formally:

(OF) The future is metaphysically open at $t =_{df}$ There are propositions P_1 and P_2 and there is a time T ($t < T$) such that

(i) the truth-value of P_1 and the truth-value of P_2 depend on (and only on) events at T
(ii) $(P_1 \,\&\, P_2) \supset \perp$
(iii) $(P_1 \vee P_2)$ is true at t
(iv) neither P_1 nor P_2 is true at t.

Example: At t, Alice tosses a coin. At T, the coin lands. (Suppose the coin cannot land on its edge, only heads up or tails up.) At t, it is true that the coin will come up heads or tails at T, but it isn't true at t that the coin will come up heads at T nor is it true at t that the coin will come up tails at T, because the result of the coin toss is unsettled as of t.

Second example: At t, Alice is contemplating a free moral decision. She must decide whether she'll watch TV or help grandma at T. (For simplicity, suppose these are the only future possibilities.) At t, it is true that Alice will either watch TV or help grandma at T. But it is not true at t that Alice will help grandma at T and neither is it true at t that Alice will watch TV at T, since at t, the future depends on a free choice that Alice hasn't made yet.

The examples might be challenged on the ground that open future is not a prerequisite for chance or free will. Perhaps we can be free, and physical processes can be chancy, without the future being open. However, I did not claim that openness is needed for an analysis of chance or freedom. All I claimed was that (OF) captures what "metaphysical openness" means, and I used chance and free will for illustration.

A more relevant worry about (OF) is that it looks very non-classical. Apparently, (OF) involves

(1) the rejection of bivalence ("The coin comes up heads at T" is neither true nor false at t),
(2) inconstant truth values ("The coin comes up heads at T" passes from being neither true nor false to being true or false), and
(3) the partial failure of truth-functionality (at t, "The coin comes up heads at T or it comes up tails at T" is true but its disjuncts are indeterminate).[1]

[1] (3) makes (OF) deviant even in terms of deviant logic. In three-valued logic, a disjunction of two indeterminates is traditionally either indeterminate (in Łukasiewicz's and Kleene's systems) or false (in Bochvar's system) (cf. Malinowski and Grzegorz 2001).

Isn't this a terrible price for a simple intuition? Isn't there a less radical analysis available?—There are three different questions in this vicinity:

(a) Is (OF) an acceptable analysis of metaphysical openness?
(b) Are there other acceptable analyses?
(c) Are any of the alternative analyses less radical than (OF)?

I think that the answer to (*a*) is YES, but I don't have a knock-down argument to offer. All I can say is that whenever I contemplate the concept of the open future, I clearly and distinctly perceive that it involves the following two ideas: (i) the future is pregnant with rival possibilities, exactly one of which will be selected, and (ii) as of now, neither of those possibilities are selected. (OF) is a principled exposition of (i) and (ii).

That said, there certainly are other analyses of metaphysical openness, so the answer to (*b*) is YES. However, I doubt that any of the alternatives come with a considerably lower price tag than (OF), so I venture to suggest that the answer to (*c*) is NO. Qualification: Some alternatives are considerably cheaper, but they miss out on important aspects of the original intuition. Let me discuss a few examples to make my point.

2 Rival theories of openness: price/performance analysis

Barnes and Cameron (2009) claim that bivalence and open future can be reconciled. They propose a framework in which every proposition is determinately true-or-false (therefore, bivalence is retained), but future contingents are neither determinately true nor determinately false. Adopting "Δ" as the determinacy operator ("$\Delta(P)$" = "it is determinately true that P"), the idea is to replace (iii) and (iv) of (OF) with something like the following:

(iii$^{\Delta}$) $\Delta(P \vee \sim P)$ is true at t
(iv$^{\Delta}$) neither $\Delta(P)$ nor $\Delta(\sim P)$ is true at t

Barnes and Cameron apply a supervaluationist framework to the openness problem, and they interpret the framework as expressing objective indeterminacy.[2] (They think the indeterminacy concerns which possible world is actual, but this detail is unimportant here.)

Arguably, this solution smacks of mystery. How can one assert in a bivalent context that a proposition P is determinately true-or-false at t yet P is neither

[2] The supervaluationist analysis of future contingents was originally proposed by Thomason (1970), but he did not suggest an interpretation involving ontic vagueness. (For his own metaphysics, see fn. 6.) Formally, the Barnes–Cameron idea is similar to Arthur Prior's (1957, p. 100) classic analysis of openness, which denies that "$\sim$(It will be the case that P)" and "It will be the case that $\sim P$" are equivalent. This move allows one to say that "It will be the case that P" and "It will be the case that $\sim P$" are both false now.

determinately true nor determinately false at t? Does this mean that P has different disambiguations? That can't be, since we're after metaphysical, not epistemic, openness.[3] Is it suggested, then, that P is true (or false), but only *a little*? That sounds strange in a bivalent context.[4] But even if one signs up to the view that bivalence holds yet reality is somehow 'blurred' in the sense of (iv^{Δ}), it is far from clear that this solution comes at a lower price than (OF). Those who suffer from intuition deficiency regarding 'bivalent blurriness' will find the Barnes–Cameron solution unacceptable, while those who possess the relevant intuitions can still rationally opt for (OF), since the choice is between bivalence plus objective vagueness versus a curious brand of trivalence. A Hobson's choice for the classicist metaphysician, with no obvious winner in terms of theoretical economy.

Other analyses of openness come cheaper but deliver less. Consider the idea that openness means nomic underdetermination:

(NU) The future is open at $t =_{df}$ For some future-oriented proposition P, and given history up to t, it is nomically possible but not necessary at t that P.

This definition passes the buck to one's theory of natural laws. For example, if natural laws are Lewis–Ramsey style "best systems," then openness looks more like an epistemic matter under (NU). But even if laws are conceived of in a more realist fashion—perhaps as relations between universals (Armstrong 1997, chaps. 15–16), or, generally, as objective structures (Sider 2011, p. 21ff),—(NU) may still turn out to be unsatisfactory. Suppose that H represents history up to and including t, Λ is the collection of natural laws, and P represents some future contingency. Then (NU) requires the following:

(NU-1) $\Lambda \cup \{H \& P\}$ is consistent
(NU-2) not: $\Lambda \cup \{H\} \vdash P$

These conditions are compatible with P's being determinately true (or false) at t. "It will rain tomorrow" and "It will not rain tomorrow" may mesh equally well with laws plus history up to now even if it is true now that it will rain tomorrow. Consider a 4D world where past, present and future are 'equally real,' so that if we quantify over the denizens of tomorrow now, the resulting proposition is determinately true or determinately false now. Such a world scarcely conforms to the open future intuition, since there is never any objective (metaphysical) uncertainty about what will happen. Yet 4D worlds can be indeterministic, so they

[3] It is arguable that supervaluationist frameworks are generally incompatible with ontic vagueness (Williamson 2003, p. 701ff).

[4] Although Barnes and Cameron (2009, p. 295f and *passim*) are adamant that they preserve bivalence, it is arguable that they do so half-heartedly. Premise (iii^{Δ}) secures excluded middle, but it does not guarantee that if P is not true now, then P is false now (which is customary under bivalence, following from $\mathrm{True}(P \vee \sim P)$ and $\sim \mathrm{True}(P)$). Indeed, the Barnes–Cameron theory *requires* that there be propositions that are not (determinately) true nor (determinately) false now. Even if this is 'bivalence' in some sense, is it bivalence in the ordinary sense?

don't rule out (NU-1) and (NU-2). Since (NU) can be satisfied even if the future is fixed, (NU) is not a sufficient condition for open future. It comes cheap but it delivers little for those who yearn for a robust conception of metaphysical openness. (Or, at any rate, that's what my intuition tells me. At the end of the paper, I'll indicate why I might be mistaken.)

A friend of (NU) might offer the following quick fix:

(NU/NF) The future is open at $t =_{df}$
(A) For some future-oriented proposition P, and given history up to t, it is nomically possible but not necessary at t that P, and
(B) The future does not exist at t.

The 'no future' proviso, (B), takes care of the previous counterexample, since for all t, the future exists at t in a traditional 4D universe, so such worlds are automatically disqualified. Of course, clause (B) is notoriously hard to defend in analytic rigour: arguably, it requires a commitment to presentism or to something like the growing block theory of spacetime. But details aside, (NU/NF) appears to rule out nomically underdetermined facts about the future, so it secures openness. Or does it? Notice that if (B) is to work the way it is meant to (i.e. if it is to rule out fixed future), we must presuppose that future contingents are made true/false by future individuals (or by future states). So (NU/NF) must be amended with something like a truthmaker/falsemaker principle. But if propositions need truthmakers/falsemakers, then bivalence must be given up, since there are no truthmakers/falsemakers for propositions about the future.[5]

The 'no future' condition, the truthmaker/falsemaker principle and the rejection of bivalence add up to a hefty theoretical package, comparable to (OF) and the Barnes–Cameron solution in price. Even if (NU/NF) is a good analysis of openness, it hardly comes cheaper than its rivals.

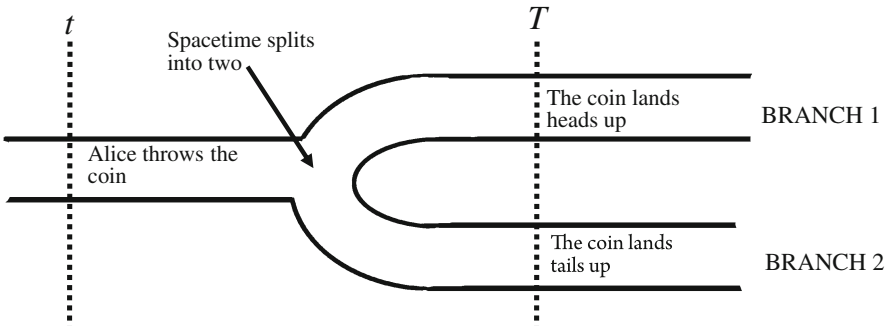
Next, consider the idea that openness is characteristic of branching spacetimes—alternative timelines split off from a common history, therefore, from the present perspective, there is no single future. More formally:

(BR) The future is open at $t =_{df}$ At some point between t and T ($t < T$), spacetime splits into two (or three etc.), and parallel future timelines fulfill the rival possibilities that are open at t.[6]

[5] Alternatively, one could retain bivalence in (NU/NF) by supposing that propositions about the future do not exist now. But then clause (A) is in trouble. One might fix this by having (A) refer to sentences instead of propositions, but then one needs to explain what it means for a sentence which does not express a proposition to be possibly true.

[6] See Thomason (1970) and Belnap (1992). Formal treatments are found in e.g. Prior (1967, Chap. VII) and Forbes (1996, p. 87ff).

The guiding image behind (BR) is that of a fork in a road:



Although attractive at first sight, (BR) fails to secure genuine openness. Let C denote the coin (or the coin-stage located at *t*, if perdurantism is assumed), and contemplate the following question: At *T*, is C located in Branch 1 or in Branch 2? There appear to be three possible answers:

(C0) At *T*, C is located in both branches: Branch 1 and 2 overlap.
(C1) At *T*, C is located in neither branch. They contain counterparts of C.
(C2) At *T*, C is located in one of the branches. The other branch contains a duplicate.

(C0) might be tenable in the coin toss case, but it turns out to be incoherent if one considers more complicated scenarios. Think about Alice's moral dilemma: under (BR), what we have at *T* is Alice watching TV in one branch and her helping grandma in the other branch. It is absurd to combine this claim with the idea that the two branches physically overlap, because Alice might do completely different things in the two branches (e.g. she might be sitting in Branch 1 and standing in Branch 2). (C0) must be rejected.[7]

(C1) isn't incoherent but it isn't a case of openness: the world has two futures, both of which are fully determinate. One contains a heads-up counterpart of C and the other contains a tails-up one. Counterpart 1, counterpart 2 and C are numerically distinct objects, and at no point between *t* and *T* is there any indeterminacy about what will happen to them. Under (C1), we only get ersatz openness because we only have ersatz identity.

Whether (C2) delivers enough depends on whether there's a fact of the matter at *t* which branch contains C at *T*. If there is, then the future is fixed. So we must suppose that there isn't—at *T*, C ends up in one of the branches, but as of *t*, its final destination is unsettled. The idea is that C travels along the common root and, at the moment of the split, it's sucked into one of the branches, like a car veering one way instead of another at a road fork. Picturesque as it is, this idea is scarcely more than mystery-mongering. Suppose that C comes up tails in Branch 1, while a counterpart of it pops into being and comes up heads in Branch 2. Now why does the generation of Branch 2 guarantee that it was open for C at *t* to come up heads at *T*? In and of

[7] For more on this point, see Lewis (1986, pp. 199–202). Against it, see Teller and Paul (2001).

itself, the generation of an extra timeline seems perfectly compatible with the idea that the original coin was fated to land one specific way. So (BR), even when amended with (C2), needs to be further supplemented with the proviso that it was *open* for C at t to enter either branch. Consequently, we need an extra openness premise—the branching itself does no real work. (BR) commands a considerable price but delivers practically nothing.[8]

Next, consider true futurism, also known as the 'thin red line' view (TRL). This influential but contentious theory was explicitly designed to overcome the paradoxes of openness. Briefly (and disregarding formal issues), the idea is that there is a privileged timeline, called "the true future" or "the thin red line," corresponding to what will actually happen. There are alternative timelines as well, branching off from each moment (in sophisticated versions of the theory, the alternative branches have their own thin red lines too). Given the existence of the extra branches, the future isn't fixed, because it is rife with alternative possibilities. Or so the true futurist claims.[9]

Whether (TRL) is worth anything in the present context depends on how the web of timelines, which is described purely formally in typical TRL-accounts, is cashed out in metaphysical terms. (TRL) is formally compatible with both (NU) and (BR), neither of which, I argued, is a theory of metaphysical openness, so (TRL) isn't by definition such a theory either. For example, one could apply (TRL) to the 4D case discussed under (NU), or to (BR) plus (C1). Arguably, the future is open in these models only in the sense that we don't know which possible timeline or spacetime branch corresponds to our (fixed) future. Yet (TRL) is formally satisfied, so (TRL), by itself, is too weak to qualify as a full-fledged theory of metaphysical (as opposed to epistemic) openness.[10] Indeed, (TRL) seems to encapsulate the commitments minimally required for *any* theory of openness, whether epistemic or metaphysical, since all such theories must make recourse to some graph-like structure representing the web of relevant alternatives.

That said, (TRL) can certainly be used to build an elegant account of the open future, one which gets around the problems I'm about to expose.

I postpone the discussion of this interpretation of (TRL) until the last section, when (hopefully) the clash between modal realism and non-TRL-based accounts of openness will already be clear. To round off the present section, let me consider two further theories that might be thought to be more parsimonious than the ones I have endorsed so far.

[8] Similar remarks apply to the 'shrinking block' model where alternative future timelines get pruned off as we go along (see Dainton 2001, pp. 72–74; McCall 1976, 1984). The existence and disappearance of such alternative timelines seem perfectly compatible with the idea that *our* world (i.e. the timeline that prevails) was fated to develop a specific way.

[9] For a helpful overview of the thin red line theory, including its connections to the medieval problem of future contingents, see Øhrstrøm (2009). The theory was originally proposed by McKim and Davis (1976) and by Thomason and Gupta (1980). The phrase "thin red line" was imported into the discussion by Belnap and Green (1994).

[10] MacFarlane (2003, p. 326) argues that (TRL) is by definition a theory of epistemic openness.

Some recent theories of openness are built around the idea of context-dependent assertibility. For example, Belnap and Green (1994, p. 383ff) emphasize that we deserve credit or discredit for what we assert, depending on how things turn out later, and they speculate that a claim like "It will rain tomorrow" is about the open future in the sense that its asserter won't automatically get credit for it—there are possible future histories where she deserves discredit because the weather turns out to be dry. In a somewhat similar spirit, MacFarlane (2003) claims that truth depends on the context of evaluation: a sentence token can express truth when evaluated in one context and can fail to do so when evaluated somewhere else. Specifically, an utterance of "It will rain tomorrow" expresses neither truth nor falsehood when evaluated today but the same utterance can express truth when evaluated tomorrow, in the context of a downpour. In theories like MacFarlane's, the future is open in the sense that utterances about future contingencies are subject to this kind of contextual variation.

Clearly, theories of context-dependent assertibility are not theories of metaphysical openness. These accounts go with a deflationary view of metaphysics or with an ambient ontology in which the question of metaphysical openness is settled independently of the pragmatics of assertion. (Both MacFarlane and Belnap/Green presuppose a TRL-like structure, without going into details about the metaphysics behind it.)[11]

Finally, consider the idea that openness is fully compatible with the existence of 'timelessly true' propositions about future contingencies. This idea is familiar from compatibilism and from the literature on divine foreknowledge. Compatibilists believe that our actions can be free even if every aspect of the future is nomically determined, while philosophers of religion following Boethius and Aquinas believe that free action and chance processes do not contradict God's perfect foreknowledge because God is not in time (see e.g. Zagzebski 1991, chap. 2; 2002, p. 51ff; Helm 1988, chap. 6). Certain theories of chance, for example David Lewis's 'New Principal Principle' (see e.g. Lewis 1994, Loewer 2004), are similarly friendly to the idea of timelessly true propositions. One might claim that such theories have a decisive advantage over expensive theories like (OF), the Barnes–Cameron solution, and the nomic underdermination/no future scenario, because the latter force us to revise logic or to adapt a controversial conception of actuality or time.

Unfortunately, openness cannot be explained by invoking theories that reconcile freedom or chance with timeless truths about future contingencies. According to the openness intuition, the future is unsettled, unfixed, indeterminate, metaphysically indefinite—there is simply no fact of the matter, timelessly or otherwise, about important aspects of it. This idea is not shown to be compatible with timelessly true propositions by reconciling the latter with free will or chance. Therefore, whatever

[11] Formally, MacFarlane's theory is very similar to (OF), my own definition of metaphysical openness, so let me stipulate that (OF) goes with a metaphysically robust conception of context-independent truth. Such a conception might be supplied by a states-of-affairs ontology (Armstrong 1997, 2004; see Forrest 2006, p. 149ff for an account of openness along these lines), or by a theory where *being true* is a primitive property of propositions (Merricks 2007). For a medieval view which has some affinity with (OF), see Hirsch (2006).

the price tag of compatibilism, Boethian conceptions of divine foreknowledge etc., and whatever their merits in explaining freedom, chance etc., these theories are not theories of metaphysical openness.

To sum up, theories of the open future come in various price categories, but the cheaper ones (and even some not-so-cheap ones) miss out on important aspects of the original intuition. I have argued that the openness intuition is best served by nonclassical theories like (OF), the Barnes–Cameron solution, or the nomic undertermination/no future scenario. In the following, I shall call these "intuition-preserving theories of openness." (I also hinted at a fall-back true futurist option which will be discussed later. Arguably, that option can also be considered intuition-preserving in some sense. At the end of the paper, I'll make a distinction between strong and weak senses of "openness" to take this fact into account. Until then, allow me to use "intuition-preserving theories" as a stipulative label for (OF), the Barnes–Cameron solution, and the nomic undertermination/no future scenario.) In the next section, I isolate a common principle of intuition-preserving theories, then in Sects. 4 and 5, I try to show that given that principle, open future is incompatible with realism about possible worlds.

3 The principle of openness

To connect modal metaphysics with intuition-preserving theories of openness, let me isolate a principle which seems to be shared by the latter:

(PO) For some times t and T ($t < T$):
(i) at T, there exists a true proposition P whose truth depends on (and only on) events at T
(ii) at t, P isn't determinately true, and this lack of determinacy is not due to the pragmatics of assertion.[12]

Example: Let P be the proposition that the coin comes up heads at T, and suppose that the outcome of the coin toss is unsettled at t but the coin does come up heads at T, so P is true at T. Depending on which intuition-preserving theory we choose, P is neither true nor false at t (under OF and one version of NU/NF), or P does not exist at t (on a different version of NU/NF), or P isn't determinately true (even though it is determinately true-or-false) at t (on the Barnes–Cameron view). In all cases, (PO) is satisfied.

In the following sections, I try to show that (PO) is incompatible with realism about possible worlds. I believe that my argument also indicates that realism about possible worlds is incompatible with the open future intuition in general. At the end of the paper, I'll gesture towards a weaker notion of openness which doesn't require (PO), but even with that qualification in mind, modal realists are in trouble whenever (PO) is around. Or so I'll argue.

[12] If tense is irreducible, (PO) must be modified: P must be a future-tensed proposition (e.g. "C will come up heads n seconds from now"), and (PO) must require that P isn't determinately true even though its future equivalent ("n seconds have passed and C has come up heads") is.

4 Openness versus modality I: Abstractionism

Realistically conceived possible worlds come in two flavours, abstract and concrete. According to modal abstractionism, possible worlds are immaterial, non-spatio-temporal objects which represent the ways our world could be (for a handy overview of this theory, see van Inwagen 2001a, pp. 169–171). One abstract world is *actual* in the sense that it represents the way our world *is*. Abstract worlds can be thought of as propositions (Stalnaker 1979), states of affairs (Plantinga 1974), or properties (I know of no such official account but Jubien 2009 comes close[13]). There is no pressing need to choose between these alternatives, because they are interchangeable.[14]

Abstract worlds are *maximal*, or *comprehensive,* or *complete* in the sense that for any proposition P and any world W, the proposition that W is actual entails P or it entails $\sim P$ (Adams 1974, p. 225, Plantinga and Alvin 1974, p. 44; van Inwagen 2001a, p. 170). Maximality is required to make abstract worlds into *worlds*, into totalities, as opposed to mere world-fragments or partial histories.

Clearly, maximality is in conflict with open future if a specific abstract world is actual now. Consider the following argument:

(A1) For some abstract world A and for all t, A is actual at t.
(A2) For any proposition P and for any abstract world A, if A is actual, then P is determinately true or determinately false.
(A3) Therefore, for all propositions P and all t, P is determinately true at t or P is determinately false at t.

(A3) is obviously incompatible with (PO). Let P be the proposition that the coin comes up heads at T. Suppose that abstractionism is true and suppose that the outcome of the coin toss is unsettled as of t. By clause (ii) of (PO), P isn't determinately true at t, and by (A3), P is always determinately true or determinately false, so P must be determinately false at t. But if P is false at t, then P is false at T as well, since there is nothing in the content of P which allows it to pass from being false at t to being true at T.[15] Therefore, P must be false and the coin cannot come up heads at T. The same argument applies to the negation of P, leading to absurdity. Therefore, the open future thesis rules out modal abstractionism.[16]

Less formally, the problem is the following: Abstract worlds represent the full history of a possible cosmos, from beginning to end, so if some abstract world is actual now, the future is fully settled now.

I can see six ways to escape this conclusion. First, one might resist (A1) by claiming that different worlds are actual at different times. But this idea makes no

[13] Note, however, that Jubien does not endorse modal abstractionism. He rejects possible worlds and opts for *ante rem* properties that code necessity through entailment relations.

[14] See van Inwagen (2001a, p. 171). See also Plantinga's 'world-books' (1974, p. 45f).

[15] This is generally guaranteed by the second part of clause (i) of (PO).

[16] More precisely, intuition-preserving theories of openness rule out modal abstractionism, but I shall drop this proviso until the penultimate section.

sense. If map *A* says that London is to the north of Paris and map *B* says that London is to the east of Paris, then at least one of the maps must be wrong no matter where we are: neither *A* nor *B* can change from being wrong to being right as we proceed in some direction. By a similar logic, maximal worlds cannot pass into and out of actuality as time goes by.

Alternatively, one can resist (A1) by claiming that it is *indeterminate* which abstract world is actual. This is the solution adopted by Barnes and Cameron (2009). The problem with this suggestion is that if the future is persistently open, it must *always* be indeterminate which world is actual: once one of them is, the future is fixed for good. Moreover, if chance processes or free beings exist up until the last moment of the universe, actuality is indeterminate even at the limit. This scenario wrecks modal metaphysics: we only have possibility, without actuality. More precisely, we have a bunch of abstract worlds none of which fits the concrete cosmos perfectly.

A defender of this option could reply that even if there is no specific actual world in her scheme, we have something like partial actuality: we have a class of worlds (namely, those that match history up to now), all of which are partially actual. But this claim is false: none of those worlds is actual because if one of them were, the future would be fixed for good. So the defender of this option must say that actuality is indeterminate between the candidate-actual worlds. However, it is conceivable that indeterminacy persists up until and including the last moment of the cosmos, so the concept of the actual world is dislodged in this scheme: conceivably, there is no actual world among the possible worlds. What we have is a bunch of abstracta none of which fits the concrete cosmos perfectly, and some of which represent it less inaccurately than others. Even worse, none of the worlds in question represent the concrete cosmos as having an open future. As a result, even if the Barnes–Cameron view coherently retains a commitment to the abstract pluriverse, it precludes the abstract pluriverse from reflecting the metaphysical profile of the concrete cosmos. Under openness, the metaphysical profile of the concrete cosmos includes the fact that the future is open, but this fact isn't reflected in the abstract pluriverse since the future isn't open *in* any of the abstract worlds. The Barnes–Cameron theory results in an impoverished abstractionism where possible worlds miss out on some metaphysically crucial facts.

To avoid this charge, one could embrace incomplete worlds, denying (A2). The problem with this idea is that the incompleteness involved in openness is transitory. On Monday, it is indeterminate whether it will rain on Tuesday, but by Wednesday, it is settled whether it did. In order to combine the idea of incomplete abstract worlds with the passing of indeterminacy into determinacy, one must claim that abstract worlds are temporally evolving entities: on Monday, world *A* (the abstractum which is actual) is noncommittal about the rain, but by Wednesday, it isn't. This idea appears to contradict the claim that abstract worlds are outside space and time. They can hardly be if they change. But taking them to be spatiotemporal threatens with absurdity, and it is a painfully *ad hoc* idea anyway.[17]

[17] In a different context, Merricks (2007, p. 76) considers a version of abstractionism where worlds only entail physically and metaphysically necessary truths, remaining silent about contingent facts. I take it that such incomplete worlds make abstractionism so heavily impoverished that it is no longer a useful theory of modality.

Fourth, the abstractionist may retort by combining the idea of incomplete worlds with the first option, the idea of changing actuality. The claim would be that on Monday, there's an incomplete world, A, which is actual; it contains no information about the future and represents the whole past. By Tuesday, the property of being the actual world passes on to A^*, a different incomplete world which is nevertheless less incomplete than A since it represents the events on Monday. Of course, the picture is a bit more complicated, because in a persistently open cosmos, actuality must change every moment, so that as soon as an incomplete world becomes actual, it immediately becomes non-actual. But this is just a formal oddity. The real problem is that the theory in question is either vacuous or question-begging. Suppose that the future is open and an incomplete world, A is actual now. A represents the history of the concrete cosmos up until the present moment, but, since the future is open and life goes on, A is about to become non-actual. Now imagine a cosmos which is just about to go out of existence. Suppose that its past is exactly like the ours. Does A represent this second cosmos too? If it does, then there is nothing about A which indicates that if A is actual, then the future is open. If the world is about to end, it evidently doesn't have an open future, and if A can represents such a world too, then A is noncommittal about openness. On the other hand, if A cannot represent a cosmos which is just about the end, then, presumably, there is another abstract world, matching our history up to now, which does. Let's call this second world "A^-."A and A^- match almost perfectly in terms of abstract content: they describe the very same history. What makes them different worlds? Here, the abstractionist must make a question-begging move: she must suppose that apart from representing the same history, A also specifies that the future is *open* (or, alternatively, A^- specifies that the future is *closed*). But the openness of the future was precisely what we wanted to explain through the abstractionist ontology. Saying that the abstractionist ontology represents openness by representing it is not very illuminating.

Fifth, the abstractionist might claim that some possible worlds contain genuine chance or genuine freedom. (I shall use chance for illustration, but the idea can easily be generalized.) If there is genuine chance in abstract world A, then, instead of entailing or precluding a proposition like "E occurs at T," A might only entail something like this:

(C) There is a 40 % chance that E occurs at T, and there is a 60 % chance that E does not occur at T.

Let us call such states of affairs *chance nodes*. If a possible world contains chance nodes, then it is not a monolithic description of how things go from the Big Bang until the Big Crunch. Rather, it is an intricate "if–then" construction, with alternate possible histories issuing forth from a nexus of moments of indeterminacy. This idea suggests the following reformulation of (A2), the second premise in the anti-abstractionist argument:

($A2^C$) For any proposition P about physical events and for any abstract world A, if A is actual, then $\Pi(P, t) = x\ (0 \leq x \leq 1)$, where $\Pi(P, t)$ is the probability that P is true at t.

If $\Pi(P, t)$ is neither 0 nor 1, we have a chance node in A with respect to P. (Π could be realized by a branching structure or in some other way, e.g. by primitive propensities. The details are unimportant here.)

($A2^C$) turns the inference to (A3) invalid provided that P isn't determinately true at t whenever $0 < \Pi(P, t) < 1$, which makes sense. By embracing chance nodes the abstractionist can import openness into the worlds themselves.

Unfortunately, this move makes abstract worlds redundant. Abstract worlds are supposed to be the truthmakers for modal claims: it's true that there might be a sea battle tomorrow because there is a possible world (sufficiently similar to ours) in which a sea battle occurs tomorrow. But once we allow for chance nodes, we have another, much more promising, truthmaker for the possibility of the sea battle, namely the relevant node itself. If the actual world contains a chance node for the battle, then the possibility of the battle appears to be constituted by this node. The sea battle is possible because the actual world is probabilistic with respect to it. It is quite irrelevant whether, in addition to the chance of the battle, there is also some abstract object representing a battle in a similar setting. And if such a representation happens to be relevant to the possibility of the battle, then we have two completely unrelated truthmakers for the same truth—we'll have a two-tiered account of possibility where some events are possible *simpliciter* (because they are represented by certain abstract objects), while other events are possible because, in addition to their being possible *simpliciter*, there is also a *chance* that they will occur. This account seems to me almost incoherent and completely *ad hoc*.

A friend of chance nodes may retaliate by dropping almost all abstract worlds and retaining only one super-maximal abstractum, which, thanks to a plethora of chance nodes, maps the open future in full. However, this abstractum cannot represent determinism, which is clearly a metaphysical possibility. Either abstractionism is impoverished, or, if we reintroduce further abstract worlds, we are back to the mysterious two-tiered account of modality.

I have examined five ways to resist the argument for the incompatibility of open future and modal abstractionism. The five solutions (changing actuality, indeterminate actuality, incomplete worlds, incomplete worlds plus changing actuality, and chance nodes) turned out to be either incoherent or were shown to make abstractionism inadequate as a full theory of modality. To wrap up this section, let me consider an option that combines the shortcomings of all its predecessors. Arguably, this is the last ditch for the abstractionist.

Suppose that abstract world A represents the coin as coming up heads at T, abstract world B represents the coin as coming up tails, and both represent Alice as tossing the coin at t. Further, suppose that the part of A which represents events up to t and the part of B that represents events up to t are the very same entity: A and B represent history up to t by numerically the same abstract world-chunk. In such a case, completeness and (PO) are reconciled: A and B are both maximal, but at t, it is indeterminate which of them is actual, since the current state of the physical universe only selects an abstract world-chunk which is common to A and B. This solution still involves an important concession, because only world-chunks, and no full worlds, can ever be actual if the future is persistently open. But we still have *something* which is actual. Indeed, we have a developing actuality, because

increasingly bigger parts of a select class of worlds are actual. This sixth solution employs *modal overlap*. Arguably, this is the closest the modal abstractionist can get to real openness.

There are two big problems with the overlap solution. The first is that the difference between overlap and qualitative similarity is wholly unclear in the case of abstract objects. According to the overlap solution, *A* and *B* represent the same history up to *t* by containing numerically the same abstract world-chunk. The difference between this claim and the claim that *A* and *B* are distinct but qualitatively similar abstract entities is almost unintelligible. Think about a debate between a trope theorist and a friend of universals. The latter says that billiard balls instantiate the very same property, *being spherical*, while the former insists that they involve distinct but similar abstract particulars—for any two balls, we have *ball 1's sphericity* and *ball 2's sphericity*, which are numerically different but similar entities. The defender of the overlap option must be committed to something like the former theory: she must say that abstract worlds are built from common elements that create metaphysical overlap. Without this sophisticated proviso, the overlap solution collapses into the Barnes–Cameron view, because the candidate-actual worlds will be distinct maximal entities none of which is actual. A defender of the overlap solution must insist that abstract worlds are not simples but 'sums' which can be partially actual by having proper parts that are fully actual. This idea is quite mysterious, and it may even be false.[18] In any case, it seems to be an *ad hoc* attempt to hack openness into the abstract pluriverse.

Moreover, even if the theory of overlapping abstracta turns out to be coherent, it still wrecks modal abstractionism the same way the Barnes–Cameron solution does, because under the overlap theory (just like under the Barnes–Cameron view), nothing represents the concrete cosmos as having an open future. Suppose that *A* and *B* are overlapping worlds which correctly represent our history up to *t* but diverge afterwards. It is perfectly conceivable that *A* is the actual world, so that the future is not open. But if *A* is actual (thereby fixing the future), then *A*'s overlap with *B* indicates nothing in itself about openness. Openness is a further metaphysical fact, unreflected in the abstract pluriverse even when we complicate the theory by adding overlap. Since openness is clearly a modal phenomenon, but this fact is missing from the abstract pluriverse even under overlap, the overlap view, even if otherwise coherent, renders abstractionism inadequate as a theory of modality.

To sum up: I have argued that modal abstractionism is in conflict with metaphysical openness, because abstract worlds are maximal and maximality contradicts a necessary condition of openness. I have examined six responses on behalf of the abstractionist. The responses involved, respectively, changing actuality, indeterminate actuality, incomplete worlds, changing actuality plus incomplete worlds, chance nodes, and abstract overlap. I argued that (1) the idea of changing actuality and the idea of evolving worlds are incoherent, (2) the idea of

[18] That abstract worlds must be simples has been argued by Lewis (1986, p. 174ff) and van Inwagen (2001b, p. 234). For the contrary view, see Jubien (1991) (esp. 264ff). The price of overlap is to allow abstract worlds to be structured, which probably leads to admitting nonactual (abstract) individuals and/or uninstantiated properties.

chance nodes renders abstract worlds superfluous, while (3) indeterminate actuality, abstract overlap, and the idea of changing actuality plus incomplete worlds make modal abstractionism impoverished as a theory of modality. I conclude that openness is in conflict with abstractionism, the first major option for the modal realist.

It is important to see what I haven't proved. I haven't proved that an open futurist cannot be ontologically committed to abstract objects that are maximal representations of ways our world could be. An open futurist is free to make such a commitment, calling the objects in question "possible worlds." What I tried to show was that such possible worlds cannot incorporate openness, therefore, given that openness is clearly a modal phenomenon, the abstract pluriverse can't give us all the modal facts. If the future is (or could have been) open, then abstract worlds can only secure an impoverished theory of modality. At best, they can be tools to structure our talk of openness, without openness itself being a feature of the abstract pluriverse. Hence, even if one is ontologically committed to the abstract pluriverse, the idea that this commitment involves a realist theory of *modality* is undermined. If the future is open, no world in the abstract pluriverse can represent actuality even remotely adequately. In that case, abstractionism will be a theory of *some* possible worlds (viz. the ones without openness), but clearly not a theory of *all* possible worlds, even less a theory of possibility in general. With these remarks in mind, my claim must be qualified: openness is incompatible with realism about abstract worlds if those worlds are meant to constitute a complete theory of modality. Since abstract worlds are posited with precisely such an intention, this qualification is not a serious concession in terms of my argument.

5 Openness versus modality II: Lewis's pluriverse

Let's move on to David Lewis's concrete modal pluriverse. Lewis's possible worlds are causally isolated spacetime systems which, by their sheer diversity, and by an incredible piece of metaphysical luck, correspond to all the ways our world (that is, *our* spacetime system) could be. For the sake of simplicity, let's assume that the modal plenum contains only two worlds, W and W^*. As we'll see, the results are easily generalized, so this simplification is harmless. Further, suppose that the only contingency in this mini-pluriverse concerns whether Alice watches TV or helps grandma cook at T. Of course, we have *two* Alices here, Alice and Alice*: they are causally isolated flesh-and-blood persons, living in causally isolated spacetimes. They qualify as modal counterparts because their properties and histories are very similar.

Suppose that for both Alices, the future is open at t with respect to what they do at T. More precisely, suppose it is open at t whether Alice will help grandma at T, and it is open at t^* whether Alice will help grandma* at T^*. (Apart from the two Alices, we also have two grandmas and two separate time orders.) Now consider the following argument:

(L1) Since W and W^* correspond to all the ways a world could be, either Alice helps grandma at T and Alice* watches TV at T^*, or vice versa. Otherwise (i.e.

if they decide to do the same thing), the pluriverse turns out to be modally incomplete.
(L2) Let *P* be the proposition that Alice helps grandma at *T*.
P isn't determinately true in *W** at *t**. If it were, then, by (L1), the future of Alice* would be fixed.
(L3) Therefore, by (L2) and (PO), the future of Alice is open in *W** at *t**.

In other words, Alice has an open future according to the time order of counterpart world—as long as Alice* hasn't decided, neither has Alice. This idea offends against the claim that *W* and *W** are spatiotemporally isolated. If something like (L3) is generally true (note that the argument is easily generalized to any class of counterpart individuals and counterpart events), then Lewis's worlds must 'move in synch', they must be parts of a larger spatiotemporal whole. The spacetime of Alice and the spacetime of Alice* must be harmonized so that it can be indeterminate for Alice* at *t** what her counterpart does in her counterpart future.

It is possible to modify Lewis's theory by making the pluriverse one huge spacetime system (see Bricker 2001, p. 45f). This would take care of the synchronization problem as far as formal consistency goes. But then the force of a well-known anti-Lewisian complaint becomes almost irresistible: it is very hard to see what a gigantic physical object like such a unified pluriverse has to do with the concept of possibility.[19]

Notice that chance nodes and indeterminacy offer no help here. Even if the future is indeterminate in Alice's world, Alice's future must be synchronized with that of Alice* in the sense that the two of them must choose differently at *T* to make the modal pluriverse complete. Similarly for chance nodes or 'freedom nodes.' Regardless of such tweaks, we can't do without the synchronization principle if we want to retain modal completeness while forcing openness into the Lewis pluriverse. But the synchronization principle makes the resulting metaphysic so weird (introducing a kind of 'modal entanglement') that incredulous stares become fully justified. Moreover, even if one has a predilection for weird theories, one cannot escape the conclusion that turning the Lewisian pluriverse into a single cosmos, which is inevitable once openness is forced into the system, yields a cosmology, not a theory of modality. Even with a predilection for weirdness, it is hard to fathom why such a heavily entangled unHumean fantasy world should tell us anything about modality. And even if one shrugs off that problem too, the resulting metaphysic will be unable to represent the world as *not* having an open future, so the concrete pluriverse is modally impoverished anyway. Apparently, the open future rules out concrete possible worlds too.

Again, overlap offers some leeway. Suppose that *W* and *W** share a common initial segment, *S*, up to *t*, so that there's an Ur-Alice (a denizen of *S*) who splits into Alice and Alice* at *t*.[20] (L3) applies to Ur-Alice only, so the argument is defused. However, the principle of openness fails for independent reasons, because the future

[19] For a succint exposition of this anti-Lewisian point, see Jubien (2009, pp. 59–67).

[20] Notice that Lewis, even though he rails against concrete overlap at length, does not object to this kind of scenario (Lewis 1986, p. 206).

of Ur-Alice is fixed. The reasons for this were discussed in connection with branching spacetimes in Sect. 2. To recapitulate, either Ur-Alice is identical to Alice, or she is identical to Alice*, or she is identical to neither (because she is only a temporal phase, let's say). In neither of these cases is her future open: in the first case, she will do what Alice does, in the second, her fate is the fate of Alice*, in the third, she goes out of existence. For the Lewisian, overlap provides ersatz openness only.

6 The thin red line revisited

Since modal realism, both in its abstractionist and in its 'genuinely realist' guises, is in dire conflict with the idea of metaphysical openness as far as intuition-preserving theories go, it is worth reconsidering an alternative that was given short shrift earlier. In Sect. 2, I promised to look at a version of the thin red line view (TRL), and I claimed that the version in question provides an elegant account of openness while avoiding the problems we've been discussing. Before wrapping it all up, I now turn to this alternative.

To recapitulate, (TRL) says that there are intertwining timelines, each of which represents a possible full history of the cosmos, and one of which (the 'thin red line' or the 'true future') corresponds to our actual past and future. These timelines can be represented by a branching tree-like structure where alternative futures histories issue from various moments in time.

As I argued in Sect. 2, (TRL) isn't by itself an account of metaphysical openness, because it is purely formal. It needs some ontic 'filling' to make it a relevant contender. To achieve this, I propose to combine (TRL) with the concept of nomic underdetermination. Specifically, I propose the following:

(T1) The thin red line corresponds to the actual past and future.
(T2) For each moment t on the thin red line, the relevant future options at t correspond to the histories after t in those possible worlds which are (i) nomically accessible from the actual world, and (ii) have the same history up to t as the actual world.
(TO) The future is open at $t =_{df}$ The thin red line isn't the only relevant future option at t.

It is obvious that the worlds picked out by (T1) and (T2) can be represented by the kind of tree-like structure which (TRL) stipulates. (If sophistication is needed, alterative timelines can have their own thin red lines by iterating (T1) and (T2) into nonactual worlds.) Moreover, it is clear that under the conjunction of (T1), (T2) and (TO), the future is open at t iff the future is nomically underdetermined at t given history up to t. In other words, (T1) + (T2) + (TO) represents a combination of (TRL) and (NU), the nomic underdetermination scenario discussed in Sect. 2. Let me call this compound theory "(TNU)."

(TNU) is compatible with both modal abstractionism and Lewisian modal realism. Indeed, it requires one or the other if (T2) is to be understood in a realist

fashion. Consequently, (TNU) avoids all the problems discussed so far in connection with intuition-preserving theories.

Is (TNU) a theory of metaphysical openness? One might argue that there is, at best, only epistemic uncertainty about the future if (TNU) is true. Indeed, this is what I clamed in Sect. 2 and this is what my intuition tells me. But I don't think that intuition is a reliable guide to philosophical truth, so I'd like to indicate why (TNU) might be considered a good account of metaphysical openness after all. This dialectical detour will help me sharpen my own account of openness, leading to a distinction between strong and weak concepts of the open future.

Suppose that Phyllis is a philosopher who is unimpressed by the recent craze about metaphysical indeterminacy. When faced with the purported problem of the open future, Phyllis delivers the following tirade:

> When we say that the future is open with respect to a situation *S,* we simply mean that *S* is possible. Of course, we don't mean that *S* is possible *simpliciter*, since the future isn't open with respect to talking donkeys and flying carpets—these possibilities are, in all likelihood, forever unavailable in our world. When we say that the future is open, we are saying that physical laws do not prescribe a specific future timeline. For example, when we say that it is metaphysically unsettled (unfixed, indeterminate) whether it will rain tomorrow, all we are saying is that natural laws do not guarantee a rainy day for tomorrow. Generally, when we say that it is *metaphysically* open (unsettled, unfixed, indeterminate) whether *S* will obtain, we assert that *S* is neither nomologically necessary nor nomologically impossible, given history up to now. And when we say that the future is *epistemically* open, we assert that we don't *know* whether the future is metaphysically open—we don't know whether the laws of nature predestine the current state of the world to develop in one specific way. There isn't any deeper sense of openness at work in assertions about the future. Those who think that there is fail to realize that the thin red line view, combined with the idea of nomological possibility, delivers all that is required to build a metaphysics of the open future.

I don't know whether Phyllis is right, but I can certainly feel the pull of her claims. Phyllis can even turn my previous arguments to her own advantage by pointing out that all the other theories of openness wreck standard modal metaphysics while (TNU), her own view, preserves it. Arguably, modal metaphysics is the very domain that should accommodate the concept of the open future, so the fact that intuition-preserving theories of openness are in dire conflict with standard modal metaphysics can be interpreted as a sign that those theories (or, more precisely, the intuitions that they preserve) are mistaken. Phyllis's tirade might be a plausible hypothesis about the nature of the mistake (if indeed there is a mistake). As far as I can see, a debate between Phyllis and someone like myself can only lead to a battle of intuitions, which means that I have no good arguments against her.

Since I don't know how to resolve this issue (I don't even know if it *can* be resolved), I propose to distinguish between two senses of openness, a strong one and a weak one.

(SOF) The future is strongly open at $t =_{df}$ (PO) is true at t, i.e. for some $T > t$:

(i) at T, there exists a true proposition P whose truth depends on (and only on) events at T,
(ii) at t, P isn't determinately true, and this lack of determinacy is not due to the pragmatics of assertion.

(WOF) The future is weakly open at $t =_{df}$ for some $T > t$:

(i) at T, there exists a true proposition P whose truth depends on (and only on) events at T,
(ii) at t, it isn't nomologically necessary (given history) that P.

(SOF) entails (WOF), because nomological necessity is alethic: if P isn't determinately true at t, then it can't be nomologically necessary at t that P. But (WOF) doesn't entail (SOF), because (WOF), unlike (SOF), is compatible with (TNU). So (WOF) is indeed a weaker concept. (WOF) corresponds to a deflated notion of openness, one on which openness simply means indeterminism.

With these provisos in mind, my core claim must be modified: If the future is *strongly* open, then modal realism is false. Further, if the future is weakly but not strongly open, then the thin red line theory seems to be the only game in town. All in all, the situation appears to be the following: You either deflate the notion of openness, or you ax modal realism. This is the take-home message of the present paper.

7 Summary

I have argued that the idea of open future is incompatible with realism about possible worlds. Having examined rival definitions of openness, I claimed that a necessary condition of genuine openness is that some propositions pass from not being determinately true to being determinately true as time goes by.

I showed that this principle fails in modal abstractionism, and I claimed that the abstractionist cannot tweak her theory without lapsing into incoherence or rendering abstractionism inadequate as a theory of modality. I also argued that reconciling openness with Lewis's concrete modal pluriverse leads either to absurdity or to a modally impoverished theory. Finally, I pointed out that a deflated notion of openness is compatible with both abstractionism and Lewisian realism, leading to a combination of the thin red line view with the concept of nomological possibility.

I conclude that those who are content with weak openness should embrace true futurism while those who are dedicated to a strong conception of openness should discard modal realism. More precisely, even if a friend of strong openness makes an ontological commitment to maximal abstracta or parallel universes, she should not suppose that her commitment constitutes a theory of modality. Friends of strong openness should believe in intraworld powers and propensities to accommodate indeterminacy, or they should be eliminativists, fictionalists, or Quinean skeptics with respect to modality. Whether weak or strong openness is the correct notion of

intertemporal indeterminacy might be a question for further debate—I have not tried to settle this issue, and I have no idea how one could.

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References

Adams, R. M. (1974). Theories of actuality. *Noûs, 8*, 211–231.
Armstrong, D. M. (1997). *A world of states of affairs*. Cambridge: Cambridge UP.
Armstrong, D. M. (2004). *Truth and truthmakers*. Cambridge: Cambridge University Press.
Barnes, E., & Cameron, R. (2009). The open future: Bivalence, determinism and ontology. *Philosophical Studies, 146*, 291–309.
Belnap, N. (1992). Branching space-time. *Synthese, 92*, 385–434.
Belnap, N., & Green, M. (1994). Indeterminism and the thin red line. *Philosophical Perspectives, 8*, 365–388.
Bricker, P. (2001). Island universes and the analysis of modality. In G. Preyer & F. Siebelt (Eds.), *Reality and Humean supervenience* (pp. 27–55). Lanham, MD: Rowman & Littlefield.
Dainton, B. (2001). *Time and space*. London: Acumen.
Forbes, G. (1996). Logic, logical form, and the open future. *Philosophical Perspectives, 10*, 73–92.
Forrest, P. (2006). General facts, physical necessity, and the metaphysics of time. In D. W. Zimmerman (Ed.), *Oxford studies in metaphysics* (Vol. 2, pp. 137–152). Oxford: Oxford University Press.
Helm, P. (1988). *Eternal God*. Oxford: Clarendon Press.
Hirsch, E. (2006). Rashi's view of the open future: indeterminateness and bivalence. In D. W. Zimmerman (Ed.), *Oxford studies in metaphysics* (Vol. 2, pp. 111–135). Oxford: Oxford University Press.
Jubien, M. (1991). Could this be magic? *The Philosophical Review, 100*(2), 249–267.
Jubien, M. (2009). *Possibility*. Oxford: Clarendon Press.
Lewis, D. (1979). Counterfactual dependence and time's arrow. *Noûs, 13*(4), 455–476.
Lewis, D. (1986). *On the plurality of worlds*. Oxford: Blackwell.
Lewis, D. (1994). Humean supervenience debugged. *Mind, 103*(412), 473–490.
Loewer, B. (2004). David Lewis's Humean theory of objective chance. *Philosophy of Science, 71*, 1115–1125.
MacFarlane, J. (2003). Future contingents and relative truth. *The Philosophical Quarterly, 212*, 321–336.
Malinowski, G. (2001). Many-valued logics. In L. Goble (Ed.), *The Blackwell guide to philosophical logic* (pp. 309–335). Oxford: Blackwell.
McCall, S. (1976). Objective time flow. *Philosophy of Science, 43*, 337–362.
McCall, S. (1984). A dynamic model of temporal becoming. *Analysis, 44*, 172–176.
McKim, V. R., & Davis, C. C. (1976). Temporal modalities and the future. *Notre Dame Journal of Formal Logic, 17*(2), 233–238.
Merricks, T. (2007). *Truth and ontology*. Oxford: Clarendon Press.
Øhrstrøm, P. (2009). In defence of the thin red line. *Humana.Mente, 8*, 17–32.
Plantinga, A. (1974). *The nature of necessity*. Oxford: Clarendon Press.
Prior, A. (1957). *Time and modality*. Oxford: Clarendon Press.
Prior, A. (1967). *Past, present and future*. Oxford: Clarendon Press.
Sider, T. (2011). *Writing the book of the world*. Oxford: Clarendon Press.
Stalnaker, R. C. (1979). Possible worlds. In M. J. Loux (Ed.), *The possible and the actual* (pp. 225–234). Ithaca, NY: Cornell University Press.
Teller, P. (2001). Against overlap and endurance. In G. Preyer & F. Siebelt (Eds.), *Reality and Humean supervenience* (pp. 105–121). Lanham, MD: Rowman & Littlefield.
Thomason, R. H. (1970). Indeterminist time and truth-value gaps. *Theoria, 36*, 264–281.
Thomason, R. H., & Gupta, A. (1980). A theory of conditionals in the context of branching time. *The Philosophical Review, 89*(1), 65–90.
van Inwagen, P. (2001a). Indexicality and actuality. In his *Ontology, Identity, and Modality* (pp. 165–185) Cambridge: Cambridge University Press.
van Inwagen, P. (2001b). Two concepts of possible worlds. In his *Ontology, Identity, and Modality* (pp. 206–242) Cambridge: Cambridge University Press.

Williamson, T. (2003). Vagueness in reality. In M. J. Loux & D. W. Zimmerman (Eds.), *The Oxford handbook of metaphysics* (pp. 690–715). Oxford: Oxford University Press.
Zagzebski, L. T. (1991). *The dilemma of freedom and foreknowledge*. Oxford: Oxford University Press.
Zagzebski, L. T. (2002). Recent work on divine foreknowledge and free will. In R. Kane (Ed.), *The Oxford handbook of free will* (pp. 45–64). Oxford: Oxford University Press.