

## Branching and (In)determinism

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**Abstract :** It might seem, and it has been argued, that if time is *linear* the threat of determinism is more severe than if time is *branching*, since in the latter case the future is open in a way it is not in the former one where, so to speak, there exists only one branch—one future. In this paper, I want to resist this claim. I shall first concentrate on what 'branching' is or could be, and I shall discuss various versions and interpretations of this view. I shall then (more quickly) turn my attention to what determinism is or could be, and I will distinguish three (well-known) kinds of it—focusing mainly on 'metaphysical determinism'. I will then ask (and answer) the question whether branching time helps with avoiding determinism or not. As we shall see, it is incorrect to think that under the branching hypothesis the threat of determinism is any smaller.

### Section 1

At a first glance, and even at a second one, it seems that if time is *linear* the threat of determinism is more severe than if time is *branching*, since in the latter case the future is open in a way it is not in the former one where, so to speak, there exists only one branch—one future. In this paper, I want to give a 'third glance' at this claim. I acknowledge that such a claim is intuitive (this is the first glance) and that it is also meaningfully and interestingly defended in recent literature where branching time is either said to imply *indeterminism* or at least to be compatible with it (this is the second glance, recently developed for instance in Belnap, Perloff, and Xu (2001), Belnap (2007), and Borghini and Torrenco (forthcoming)).

To try to make my third glance as precise and as fleshed out as possible, I shall first concentrate on what 'branching' is or could be, and I shall discuss various versions and interpretations of this view. I shall then (more quickly) turn my attention to what determinism is or could be, and I will distinguish three (well-known) kinds of it—focusing mainly on

‘metaphysical determinism’. Having these tools in hand, I will then ask (and answer) the question whether branching time helps with avoiding determinism or not. As we shall see, it is incorrect to think that under the branching hypothesis the threat of determinism is any smaller—rather, I will argue that if one has reasons to think that determinism is true, branching will not help, and that the issue of branching *versus* linear time is then actually neutral with respect to the question whether determinism or indeterminism is true. (I will say nothing in this paper about the (in)compatibility of determinism with human free will.)

## Section 2

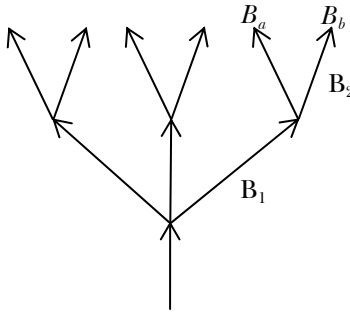
In the title of this paper, I have on purpose left open what it is that is branching—there are at least these three possibilities:

- branching time
- branching space-time
- branching (structure of possible) worlds

It is quite important to clearly distinguish between these three views, since they are very different one from each other, and since this ‘tristinction’ is not always clearly made.

Importantly, but I hope quite obviously, branching *time* is a silly idea. I cannot really say why it is silly, because I can’t understand what it would even *be*—a universe where there is only one, say three-dimensional, *non-branching space* but where time would have a branching topology? What would happen at a fission point where time branches? Time would split into two or more branches but space would not? A lizard running from a predator would lose its tail in one branch but not in the other—and all this in the same space? This just does not make sense, and even philosophers should not try to make sense of it. Rather, of course, we should take into consideration the view that *space-time* could have a branching structure—*this*, of course, is a perfectly meaningful idea where at every fission point space-time branches into one or more post-fission

spatio-temporally disconnected space-times. This is how such a structure can be understood:



Labels ‘ $B_1$ ’ and ‘ $B_2$ ’ refer to branch-segments, while labels ‘ $B_a$ ’ and ‘ $B_b$ ’ refer to whole branches—totalities of branch-segments that form a complete branch. Before I discuss this branching framework in more detail, there arises a general question of how to interpret such a structure. There are two main possibilities: either one can interpret it as *one world*, one universe, where space-time has a branching structure (this is Belnap’s ‘One World’, see Belnap (2001, 2005, 2007)), or one can see such a framework as a modally loaded one where the branching structure is seen as a branching framework of *possible worlds* where each branch is a world (this is a view discussed, but not defended, by Lewis (1986, p. 206-209) who prefers a non-branching ‘divergent’ framework of possible worlds; I also discuss this view in detail in Benovsky (2005)).

The question here is *not* a metaphysical one, rather it is a question of how to *interpret* such a metaphysical structure (supposing it exists). Can it provide a framework for analysis of modal talk? Can alethic modalities be understood in terms of a branching space-time structure? While this is not the central point of this paper, it merits our attention, since clarifying what a branching structure is helps our understanding of it and thus our understanding of how it bears on the question of determinism. Let us (quickly) see.

### Section 3

Lewis prefers a ‘divergent’ framework of disconnected space-times to play the role of possible worlds, rather than a branching framework of space-times that share an initial segment (or segments), mainly for the reason that spatio-temporal isolation provides him with a clear criterion to distinguish between different possible worlds: a world is a maximally intra-connected space-time, anything that has any spatio-temporal relation to it is part of it, and anything that has no spatio-temporal relation to it is part of a different world which is also an independent space-time (see Lewis (1986)). This is Lewis’ main somehow *ad hoc* reason for not endorsing a branching structure of possible worlds (since it spoils his preferred way of individuating worlds), but there are some other problems as well.

One worry could be that such a structure would, at best, provide us with *nommic possibility*, rather than metaphysical possibility. While this worry does have some bite to it, perhaps a hard-core friend of branching could reply by saying that the phenomenon of fission (where one branch splits into two or more branches) obeys not physical laws but ‘metaphysical laws’ that is, a split occurs whenever something is metaphysically possible, and not just physically possible—this can be even embodied by definition in what a structure of branching possible worlds is. But, it would still remain true that all possible worlds, necessarily, would have to share the very same initial state, which might be enough for the objector to remain unsatisfied (for discussion, see my Benovsky (2005, p. 19)).

A strong objection to the modal interpretation of a branching space-time structure is actually very similar to a strong objection to the Lewisian modal interpretation of a non-branching, divergent, mutually disconnected space-times structure: I have in mind Bricker’s (2001) article where he convincingly argues that so-called ‘island universes’ are a metaphysical possibility. The notion of ‘island universes’ refers to the possibility that there is *one* possible world that contains *several* mutually spatio-temporally isolated space-times (‘islands’). If, as Bricker argues, this *is* a metaphysical possibility, then Lewis is in serious trouble since he

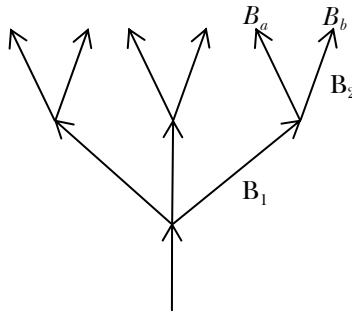
cannot use anymore spatio-temporal disconnectedness as a criterion for individuation of possible worlds. And, relevantly to our interests here, if this objection works against the Lewisian framework, it is also a serious threat to a modal interpretation of a branching space-time structure as well, since first, nothing guarantees that it is not a metaphysical possibility that there exists other branching structures that have a different initial segment (and so, that are spatio-temporally fully disconnected from each other—there exist several fully disconnected trees, so to speak (this is, basically, the same objection as Bricker’s)), and second, such a modal interpretation of a branching space-time structure would make it metaphysically impossible for *one* world to have a branching space-time topology (since a branching structure is, by definition, a structure of several worlds, not one (this is an additional objection, not Bricker’s)).

There probably are (more or less satisfactory) replies to all of the objections quickly mentioned above (see for instance Lewis (1986, p. 69–78)). What is of interest for us now is that whichever interpretation of the branching space-time structure (be it a modal one or a non-modal ‘One World’ one) is correct, the question of determinism does arise—either in terms of ‘alternative’ futures that are all part of one world (this is the ‘open future’ intuition) or in terms of other ‘possible’ futures. Indeed, as I already pointed out, from the metaphysical point of view, there is no difference between the modal and the non-modal understanding of such a branching space-time structure. It is composed of branch-segments (‘ $B_1$ ’ and ‘ $B_2$ ’ on the figure above) that form complete branches (‘ $B_a$ ’ and ‘ $B_b$ ’) which one can call ‘worlds’ or ‘world-branches’ under the modal interpretation or simply ‘branches’ under the non-modal one. (I shall stick to the non-modal terminology in what follows.) Each entire branch of the structure that begins at the origin is thus made of temporal parts—the branch-segments—and a branch is thus defined as an ordered aggregate of branch-segments. Two branches can thus spatio-temporally overlap, by sharing one or more temporal parts (that is, by sharing a more or less long initial branch-segment). Importantly, in this view, all branches have the same ontological status, all are equally real, equally

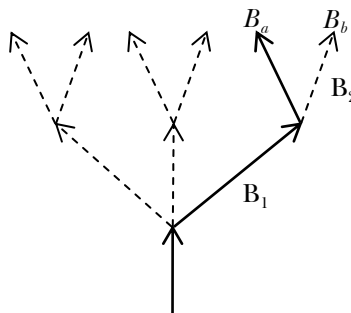
concrete, entities—at least according to the most standard understanding of such a branching framework. But there are other possible variants of it.

#### Section 4

I shall now distinguish three versions of the branching framework view. The standard version of branching space-time, under the modal interpretation as well as under the non-modal one, takes all of the branches to have the same ontological and theoretical status.

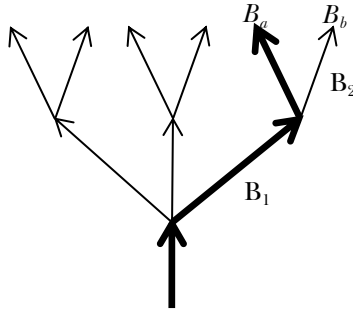


But, exactly as many are not happy with this strongly realist claim in the case of the Lewisian divergent framework of possible worlds (where all possible worlds are also said to have the same ontological status), one may not be happy with such strong realism about all of the branches, especially if one wants to make this framework modally loaded. Thus, one could want to have an *ersatzist* version of this branching structure in mind, as illustrated on the following figure.



The ersatzist idea is that only one branch is real (concrete, spatio-temporal), while the other branches are ontologically different: perhaps they are some abstract and/or linguistic representations—in a manner similar to how modal ersatzists explain the nature of possible worlds (see for instance Van Inwagen (1985, 1986), Lewis (1986, chapter 3), Heller (1998a, 1998b), Sider (2002)). We will see the relevance of such a move to the issue of determinism below.

Third, more closely to the first version of the branching framework, one may want to keep the idea that all branches are equally real and have the same ontological status, but still want to claim that *one* of the branches is *privileged*: one of the branches is *the* future that is going to happen, while the other branches are ‘only’ alternative futures.



This version encompasses the idea of a so-called ‘Thin Red Line’—the future that is going to be ‘the one’.<sup>1</sup> While, on the one hand, one of the branches (that is, one of the futures) is said to be privileged, the Thin Red Line view is often introduced as a ‘version of indeterminism’ precisely because, on the other hand, it includes ‘the doctrine of an open future filled with real (incompatible) alternatives’ (Belnap, Perloff, and Xu (2001, p. 133)). Thus, such a view wants to claim *both* that all branches are equally real and concrete, *and* that there is *one* future that is the one that is going to happen—the privileged branch.

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<sup>1</sup> For a detailed discussion of the Thin Red Line, see for instance Belnap and Green (1994), Belnap, Perloff, and Xu (2001), and Borghini and Torrenco (forthcoming).

But what does ‘privileged’ mean? It cannot mean ‘ontologically privileged’, since by definition the view here is *not* an ersatzist one; rather it is a view according to which all branches *equally* exist (they do have the same ontological status, they are of the same ontological category, they do not exist ‘more’ or ‘less’ in any sense—*à propos*, this is one of the differences between such a view and the Everettian Many Worlds interpretation of quantum mechanics since under *this* view different branches are assigned different probabilities (see Everett (1957), Wheeler (1957), De Witt (1970), and De Witt (1971))).

Trouble is, there is no good reply, or even no reply at all, to what makes one branch privileged over the others. The only meaningful thing the defender of the Thin Red Line can say here is that it just is a *brute fact* that one of the branches is the Thin Red Line—the one future that is going to happen.

Interestingly, such a claim parallels the debate about what ‘actual’ means if one has a modal interpretation of the first version of the branching space-time framework. Indeed, under this version, one can ask: in virtue of what is a world the actual one? What sort of privilege actuality is? And, interestingly, there is no good answer to such a question either—it is notoriously a bad idea to claim that actuality is anything like a special ontological privilege or a special property that one branch would have and the others would not (such a claim would be theoretically under-motivated and would lead to scepticism about one’s own actuality). Rather, the only plausible answer is to say that ‘actual’ is no more than an indexical term (and so, *not* a privilege), and that any world can be truthfully called ‘actual’ by its inhabitants since it means no more than ‘*our* world’. No problem, then, for the friend of the modal interpretation of the first version of the branching framework (and, incidentally, no problem for the friend of the Lewisian theory of possible worlds either, since the same strategy is used there as well, of course). But, for the friend of the Thin Red Line view, such an answer does *not* do the trick. Under such a view, one *does* want to say that there is something that makes one branch privileged over the others, and an



indexical claim would just be too weak here to do the job. Back to square one: the only plausible answer one can provide here is to claim that the fact about which branch is the Thin Red Line is a brute unexplained fact—it *just is* the future that is going to be.

To my mind, this makes the Thin Red Line view much less appealing than the other two versions we have seen above, but let us grant for our purposes here that it can be made to work, and let us concentrate on the question of how the various branching views connect to determinism.

### Section 5

There are three main (well-known) kinds of determinism. The terminology surrounding them is a little unsettled in the literature, so let me quickly clarify and explain how I will use some technical terms and what I will refer to by them. The three kinds of determinism I have in mind can be labelled as

- metaphysical determinism
- causal determinism
- logical determinism

I do not use here the term ‘fatalism’, although it is sometimes used for one (or more) of the kinds of determinism I have in mind. In my terminology, I reserve the term ‘fatalism’ for the doctrine that, *given* some kind of determinism, humans do not have free will and that ‘all effort is futile’ with respect to our future actions. ‘Fatalism’, in my words, refers then to an attitude towards our actions, *under* a deterministic hypothesis. I shall say nothing in this paper about this interesting issue (see, for instance, Dummett’s (1964) excellent paper), and in general I shall not discuss here the important, interesting, related, but different, issue concerning the (in)compatibility of determinism with human freedom and free will (for a discussion see, for instance, Oaklander and Smith (1995), and Oaklander (1982, 1998)).

*Metaphysical determinism*, which is the kind of determinism that I will be mainly concerned with in what follows, comes from considerations about the nature of time. Indeed, if *eternalism* is true, that is, if the inventory of all there exists in the universe includes all past and future times and entities as well as present ones, then the future is, metaphorically speaking, ‘already there’ (as well as the past and the present). It is thus determined simply because it exists.<sup>2</sup> Eternalism is the doctrine about time which takes future and past objects to exist in the same way present objects do—there is no ontological difference between past, present and future; as Ted Sider puts it: ‘Just as distant places are no less real for being spatially distant, distant times are no less real for being temporally distant’ (Sider (2001, p. 11)). In the eternalist’s manner of speaking, future objects ‘exist’, as well as present objects exist, in an atemporal sense of the verb; it is as if one were viewing the universe from a God’s standpoint and could contemplate all that happened, happens and will happen laid before his eyes (Arthur Prior calls this ‘the tapestry view of time’ (Prior (1996, p. 47)). No surprise, then, that under such a view the future is ‘already fixed’, in a metaphysical way.

*Causal determinism* comes from the idea that every event has its cause. This is said to entail determinism because given a state of the universe at a time *t*, and given natural laws, the way things are after *t* is fixed—determined.

*Logical determinism* is thus called because it comes from troubling considerations concerning the principle of bivalence—it can be put as the claim that the principle of bivalence holds for all propositions, including propositions about the future. The typical argument for such a kind of determinism, that nicely explains what the view is, goes as follows (in one of its simplest forms):

- a. either the proposition that a sea battle will happen tomorrow is

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<sup>2</sup> Such a claim, which is to be clearly distinguished from the claim that there is no freedom or free will (see above), is to be found for instance in Oaklander and Smith (1995, p.119-120) and Slater (2005, p.365).

true, or the proposition that it won't happen is true [applied principle of bivalence]

- b. if a statement is true, then it has to be true
- c. whether or not a sea battle will happen tomorrow, whichever will happen is something that has to be
- d. whatever will be, has to be

### Section 6

In this paper, I am working under the *assumption* that if time is linear, some kind of determinism is true. This is of course a very strong assumption, and I do not aim at defending it here; rather my aim in this paper is to see whether *if* that is indeed the case, a branching space-time view can be of any help (that is, if it can help to *avoid* determinism). To my mind, the assumption is strongest if one has in mind metaphysical determinism, so I shall start with this view, and see whether it can be avoided if one embraces the first (full-blown realist) version of the branching framework we have seen in Section 4 above.

At a first glance, it seems that determinism holds here as well as under a linear time hypothesis. Indeed, if eternalism is true, the future 'already' exists, branching or not. But here is the branching idea: since there is not only one branch but a great number of them, doesn't this leave the future *open*? If, for instance, I decide to climb on the Everest tomorrow, when I consider my future, it seems that there are many alternative outcomes of this attempt corresponding to the many branches where different alternatives take place—in some branches I die due to my lack of training and experience, while in others I (rather miraculously) successfully get to the summit.

So, is the future fixed ('already there') or is it open? I think that to properly answer this question it is crucial to have a good understanding of the phenomenon of *fission*, and of the problem of knowing 'on which branch I am'—indeed, the branching space-time view is 'no more' than a generalized theory of fission (a theory of fission where fission is

omnipresent), of which many (non-generalized) examples are to be found in the literature about personal identity and persistence through time. A small detour in the land of theories of persistence is thus in order now.

Given eternalism (rather than presentism), perdurantism<sup>3</sup> has been defended as being the best theory of persistence around because it allows one to avoid problems with coincidence without having to embrace strong unwelcome claims, contrarily to other alternative views. Such problems include the statue/lump case, the Tib/Tibbles case, and, relevantly to us, several versions of puzzle cases featuring fission scenarios (see Sider (2001, chapter 5)). Let us examine one such scenario more closely.

Commander William Riker, when he was a Lieutenant on the *USS Potemkin*, was once, during a rescue mission, transported from the planet Nervalia IV back to the starship but due to a malfunction of the transporting device, he was *also* left behind.<sup>4</sup> Indeed, the transporting device on the *USS Potemkin* works by ‘scanning’ Riker at a sub-atomic level, destroying the particles of which Riker is made, and assembling in some other place other particles in exactly the way Riker’s particles were arranged. These new particles arranged Rikerwise are then Riker, after having been transported from one place to another, and we are invited to grant that such a procedure *is* a case of transportation and *not* of death of one individual and creation of a second one (if you’re unable to accept such an invitation, you should then appeal to another type of fission scenario—transplants of halves of brains, for instance, have been quite popular in the philosophical literature on this topic). If one does grant that such a scenario is indeed a case of transport rather than death, and if the transport mechanism malfunctions in such a way that it ‘rebuilds’ Riker not only on the *USS Potemkin* but also on Nervalia IV (on the very spot where the ‘scanning’ took place, so that Riker there gets the impression that he was not transported at all), we have then a case of fission: one Riker continues to live on Nervalia IV, merely thinking that

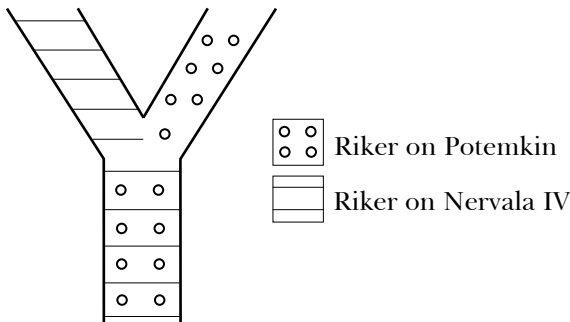
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3 When speaking about perdurantism I shall have the ‘worm view’ in mind; but one can equally well appeal to the perdurantist ‘stage view’ in all I will say below.

4 *Star Trek TNG*, season 6, episode 24 ‘Second Chances’.

the transport failed, while another Riker continues to live on the *USS Potemkin* thinking that the transport succeeded (only eight years later, during another mission, do the two Rikers realize what happened when they accidentally meet).

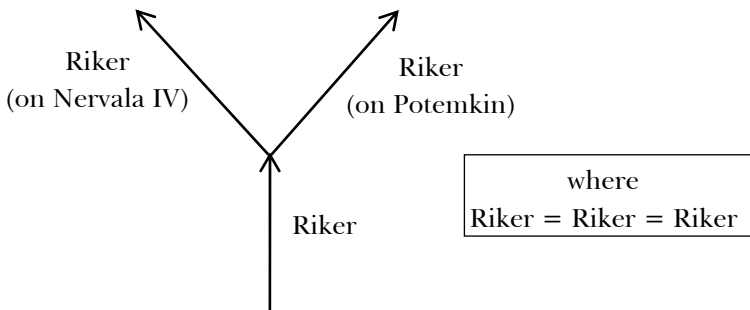
There is no good and unproblematic answer to the question which Riker is ‘the right one’, and this is why, when facing this question, perdurantism has the great theoretical advantage of easily dissipating any metaphysical worries, leaving only semantic problems to be solved (probably, by simple acts of definition) since, according to perdurantism, there are *two* space-time worms corresponding to each Riker, and thus, to *each* answer to the question ‘Which one is Riker?’ (see, for instance, Sider (2001, chap. 1) and Lewis (1976)).



Indeed, according to this version of perdurantism, people like Riker are temporally extended four-dimensional space-time worms that are made of temporal parts (temporal parts are like people except that they are temporally smaller). The case of fission is then no more than a case of sharing of parts: two different worms have a temporal part in common, namely the temporal part that goes from Riker’s birth to the moment of the transport. Such a scenario is often compared to the spatial case of sharing parts where a road forks: we have two roads that share an initial (spatial) segment.

People thus persist through time not by wholly existing at different times but rather by being temporally extended. This allows perdurantists

to avoid having to say that the thing (the temporal part) that exists at a time  $t$  is numerically identical to the thing that exists a later time  $t'$ —which becomes helpful precisely in cases like the case of fission. Indeed, if one were to claim that persistence through time works *via* numerical identity in an endurantist fashion, one would end up having to say that Riker before fission is identical to Riker after fission on Nervalia IV, *and* that Riker before fission is identical to Riker after fission on the *USS Potemkin*, which, by transitivity of identity, would lead to the absurd claim that Riker after fission on Nervalia IV is numerically identical to Riker after fission on the *USS Potemkin*.



To avoid this absurdity resulting from transitivity of identity, one could want to claim (for example) that there were *two* Rikers all along—even before the fission occurred—but such a move is typically taken to be an unappealing one because of its commitment to coincident entities, that is, numerically different concrete entities that somehow occupy the same space-time region. The perdurantist treatment of fission does not have any such unpalatable consequences.

My short exposition of how perdurantism elegantly solves problems with coincident entities involved in fission scenarios does not of course by far exhaust the debate. All I wish to accomplish here is to present what, in my mind, is the best understanding available of cases of fission, in order to be able to provide a good understanding of generalized fission: the branching hypothesis. Perdurantism, to my mind, is such a

useful tool here. But before I go any further, I wish to mention a yet another usefully parallel claim about actuality, that will help us to understand the question of ‘on which branch I am’.

Indeed, as we have already seen, if one had the modal interpretation of the branching framework in mind, one could ask questions about actuality: how are we to distinguish between the actual world and the others? How do we know that we inhabit the actual world? To these questions, we already know the appropriate reply: ‘actual’ is an indexical term, like ‘here’ or ‘I’, which expresses simply the fact that I, who am writing here at this moment, am speaking about the world I inhabit—likewise, inhabitants of other worlds can use the word ‘actual’ to speak about their own world, the one they inhabit.

But, how exactly does this indexical conception work under the branching framework? Indeed, under the branching hypothesis, not only space-time (or worlds) has a branching structure, but me as well: in a perfectly intelligible sense, I *am* branching as well as the world (or the worlds)—how do I manage then to live in only one branch (or world) and denote it when I use the term ‘actual’?

According to the perdurantist account, in Riker’s case, there is an individual  $I_a$  (I use the same notation as before in Section 4; complete life-long worms are labelled ‘ $I_a, I_b, \dots$ ’ and worm-stages are labelled ‘ $I_1, I_2, \dots$ ’) which has as parts the individual-stages  $I_1$  (pre-fission) and  $I_2$  (post-fission, on Nerval IV), and an individual  $I_b$  which has as parts the individual-stages  $I_1$  and  $I_3$  (post-fission, on the *USS Potemkin*). The individuals  $I_a$  and  $I_b$  have one of their parts in common (namely,  $I_1$ ) but that does not make them identical, they merely overlap. Now, when  $I_1$  (Riker before fission) says ‘I’ what is the denotation of this term? Is he speaking about the individual  $I_a$  ( $= I_1 + I_2 + \dots$ ) or the individual  $I_b$  ( $= I_1 + I_3 + \dots$ )? And, similarly, when  $I_1$  uses the expression ‘the actual world’ or, under the non-modal interpretation, ‘this branch’, is he speaking about the branch that includes his staying on Nerval IV or the one that includes his boarding the *USS Potemkin*? In such cases of branching, due to occurrences of fissions, a temporal part of Riker such

as  $I_1$  is part of more than one branch, but then, if we embrace the indexical analysis of actuality, what does Riker refer to when he uses the expression ‘the actual world’ or ‘this branch’? He is speaking about ‘the world I am in’ or ‘the branch I am on’—but which one of the two branches is the one being referred to?

The important point to remember here is that the two branches are, at the time of utterance, just one single branch: when Riker pronounces those words, he is part of two overlapping branches at once (but only at the time when they are one) and, consequently, if by those words, he denotes the branch he is on, he is denoting all of the branches that contain  $I_1$  as a part. But let us keep this in mind: people like Riker are individuals that cannot be said to inhabit more than one branch (or, more than one world)—it is  $I_1$ , which is a temporal part of Riker (his individual-stage ‘at the time of utterance’), who pronounces those words and who can be said to be part of more than one branch (or world)—as far as those branches are one, before a fission occurs—and who is ambiguously speaking about two branches. The same holds in the case where Riker’s pre-fission part  $I_1$  says ‘I’ or ‘this bottle of beer on the table’—all those singular terms denote a plurality of things which have a common part, exactly as  $I_a$  and  $I_b$  share  $I_1$ . Hence, the word ‘I’ uttered by  $I_1$  refers to two different individuals but only at a time when those individuals are one (before a fission occurs). One could find genuinely absurd to conceive that by a singular term one can refer to more than one thing at once: but the linguistic strangeness is only rooted here in the fact that in our ordinary talk we usually never take into account the possibility of branching—the generalized existence of fission cases. The linguistic phenomenon at hand here is what Mark Heller calls ‘multiple contents’ (see Heller (2000, p. 375-376)). Heller provides us with a nice crossword example [see table on following page]. In this case, as Heller points out, the word ‘this’ has a multiple content: it denotes the horizontal sentence, as well as the vertical one (one being true, the other false). Once this is accepted, there is no problem in Riker’s case: the words ‘I’ or ‘actual’ or ‘this bottle of beer’ in  $I_1$ ’s mouth work similarly—



there are two contents, two meanings expressed.

This	sentence	contains	exactly	six	words.
sentence					
contains					
exactly					
three					
words.					

**Section 7**

We now have a clear and detailed picture in mind of the branching scenario, understood as a generalized theory of fission under a perdurantist interpretation. The components of such a scenario are: eternalism, branching space-time (modally interpreted or not), perdurantism, and an indexical theory of ‘the branch I am on’, ‘I’, ‘the actual world’, and so on. Now, what about determinism *versus* the openness of the future? I have done a lot of ‘preparatory’ work in the preceding pages, in order to be able to say now in relatively few words something that, I hope, is quite simple and that stems from the preparatory considerations above.

Branching is supposed to help with avoiding determinism. But it does not. Remember my attempt to climb on Everest (Section 6 above): I will start my ascent tomorrow, various different alternative (one could want to say ‘possible’) outcomes are realized in different branches in the branching space-time structure—and *all are equally mine*. In some of them I (I, myself!) die, in others I (I, myself!) survive and get to the summit, and so on. I, that is, my temporal part writing this paper the day before the ascent, am related in the very same way to all the temporal parts (individuals-stages of the type  $I_1, I_2, I_3, \dots$ ) that will inhabit the

future branches—some of them dying, some of them celebrating success—and no one of these future temporal parts of mine is to be privileged (not ontologically, and not otherwise either). Of course, as in Riker's case, I will not lead a 'multiple life' where I would have 'at once' the experiences of a dying person *and* the experiences of a person who is celebrating, since *after* fission, the dying person and the celebrating person are different individuals. But before a fission occurs, before space-time branches into alternative futures featuring alternative outcomes of my ascent, it is correct to say that all of these futures are equally mine. Since I will undergo fission, I will thus, in a perfectly respectable sense, succeed to climb on Everest *and* fail to climb on Everest—and I am not contradicting myself when I say that, exactly as there is no contradiction in saying that one of the future branches contains a sea battle and another does not, such is simply the consequence of the occurrence of fissions.

The important thing to bear in mind is that under the framework we are working with now (especially its eternalist component), all of the alternative futures-branches *are there*. In a determinist way of saying it 'everything that can happen *will* happen' under such a framework. Granted, this is a different form of determinism than the usual one (where time is thought of as being linear, instead of branching), but this is only so because of the difference between a branching hypothesis and a linear one, and it makes no difference to the determinist core idea. The usual type of metaphysical determinism (under a linear time hypothesis) says: *the future* is there, the future is fixed rather than open because it 'already' exists, and I will be part of it. The branching type of metaphysical determinism says: *the futures* are all there, they are all fixed because they 'already' exist, and I will be part of (all of) them ! This is no metaphor: I, in the fullest (perdurantist) sense of 'I', will be part of all these futures, due to the existence of fission (branching). Exactly as there is no good reason to privilege one branch as being ontologically privileged over the other branches (no absolute actuality but rather indexical actuality) there is no good reason to privilege one of the future

‘mes’ as being ‘the me’ who will be me. I will be all of them, all of the alternative futures will be equally—and *unavoidably!*—mine,<sup>5</sup> and thus determinism holds here as well as under a linear time hypothesis.

## Section 8

In this paper and in what I said in the preceding section, I focus mainly on metaphysical determinism, but the claim I developed above could be adapted to work under logical determinism or causal determinism as well. The claim I want to focus on is whether, if determinism is true under a linear time hypothesis, branching can be of any help to avoid it. Thus, in what follows, I shall keep working under the metaphysical determinism hypothesis, consider the various kinds of the branching framework we have seen in Section 4, and see whether the ersatzist branching view or the ‘Thin Red Line’ branching view can be of more help than the ‘standard’ branching framework I have appealed to in the preceding paragraphs.

The ‘Thin Red Line’ branching framework (‘TRL framework’, for short) makes a move that the standard framework took care to avoid: to claim that one of the branches is, somehow, privileged. We have seen that such a privilege is under-explained and can only be stated as a brute fact: one of the branches is *the* future that is going to happen, while the other branches are ‘only’ alternative futures. I have already objected to the lack of explanation involved in this claim, but now we see that such a view fails for even stronger reasons, for it is just false to say that only one of the branches will happen. The TRL framework is *not* an ersatzist framework, and thus *all* of the branches *will* be realized. Thus, exactly as under the standard framework, there will exist multiple branches on which I, Riker, and everybody will live different alternative lives, realizing different alternative futures. Even if, somehow, we grant the friends of TRL a mysterious and brute privilege to be given to one of the

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<sup>5</sup> David Lewis defends a very similar idea (namely that, roughly speaking, ‘I will live all of the futures’) under the Everettian Many-Worlds interpretation of quantum mechanics; see Lewis (2001) where he explores what he takes to be very troublesome consequences of it.

branches, *this does not make the other branches non-existing!* When Belnap, Perloff, and Xu (2001, p. 133) introduce the TRL view, as we have already seen, they also recognize this important fact when they say that it is ‘the doctrine of an open future *filled* with real (incompatible) alternatives’ (my italics). They are right about the fact that the TRL framework includes all of the alternative futures, but they are wrong, I submit, to say that this is a ‘version of indeterminism’ (open future)—for exactly the same reasons this is wrong under the standard branching framework, as we have seen in the preceding section.

A final note on TRL: *even if*, somehow, one were to grant that, contrarily to what we have seen above, only *one* of the futures is mine (and Riker’s, and so on)—that is, there is a Thin Red Line which is *the only* future that I will live—this would be of no help with avoiding determinism. Indeed, in that case, since it is a given brute fact that such-and-such a branch is *the* future I will going to live, it is then determined exactly as under a non-branching linear time hypothesis (the other branches are here, wrongly but fatally, ignored).

Finally, let us turn our attention to the ersatzist branching framework. The ersatzist idea is, to my mind, more understandable and better motivated than TRL since it gives one branch a clear and well-specified *ontological* privilege: *only one* branch is concrete (spatio-temporal), while the other branches are of a different ontological kind (typically, some sort of abstract and/or linguistic representations). What about determinism, under such a view?

If some kind of determinism is true under a linear time hypothesis (which is the assumption I am working under throughout the whole paper), it is *not* avoided by the ersatzist framework—no more than it would be avoided by a framework with only one concrete linear-time world and other ersatz non-branching abstract possible worlds (that is, under typical modal ersatzism). Indeed, what we have here is *one* future, that is going to be realized, and many unrealized alternative futures that I will *not* live (*unlike* under the standard branching framework and TRL). Indeed, the ersatzist view is not really a branching view: nothing

really branches here, so to say. There is one concrete branch (world), that is a linear one, and there are abstract representations of what the one concrete branch (world) could be, and that's it. No real phenomenon of fission (branching) ever takes place under such a scenario. I thus have many *possible* futures, that I will not live, but I have only one future that I will live, and if there are any reasons to think that it is determined (causally, logically, metaphysically) under a non-branching linear time hypothesis, they apply here as well with exactly the same force.<sup>6</sup>

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