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OPEN FUTURE IN ETERNALIST UNIVERSE

Master`s Thesis in Philosophy

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Tartu 2019

I hereby affirm that I have written this Master's Thesis myself. All statements and opinions by other authors have been quoted accordingly.

20.05.2019

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1. INTRODUCTION

Universe is all of space and time. Stars, planets, animals like you and me, and every other form of matter and energy are its contents. According to our best scientific theories, we live in a 4-dimensional (4D) universe, where everything that has been, is, or will be, exists on a par. This is to say that dinosaurs exist just as you and me, and you and me exist just as future outposts on Mars (if there will ever be any) do. Space and time are combined into one big static block, where time is just another dimension. This kind of spacetime is called eternalism in the current Master's thesis.

This view of time might raise concerns, however. Existing in this eternalist universe, we express a myriad of different intuitions, such as the intuition that we have a free will, that time is flowing, or that the future is open. Yet, the more we learn about the physical world around us, the less these intuitions seem to be correct. Temporal flow is incompatible with the static 4D block theory, for example; free will seems to run into conflict with determinism, as does open future.

At least at first glance.

In this thesis, I will take the possibility of open future in an eternalist universe under scrutiny. I am interested in if we can make any sense of the notion of open future in such a universe, and if we can then what would it look like. Hence, I will pose the following research questions:

RQ1: Is open future compatible with eternalist universe?

RQ2: If yes, then in what sense is the future open in eternalist universe?

There are two further constraints I will set in attempting to answer these RQ-s. These are the principle of bivalence, and causal determinism. The principle of bivalence holds that it is always either p or $\sim p$; causal determinism in short is the position that everything has a cause. Both of these are attractive and are better not given up. Moreover, giving up either of them would make the future trivially open, and the current research would lose its point. Therefore, I will be keeping causal determinism and bivalence in mind, and will try to answer the two RQ-s without violating either of these principles.

I think there are several good reasons for carrying out this research. Firstly, almost all of us have very strong intuitions of the open future. I am in Japan now, with a Japanese government scholarship. The scholarship application and university selection, and placement, was almost a year long process. For most of this time, I was quite unsure of what was going to happen to me

next year. I had no idea, if they will accept my scholarship application, if the university I wanted to enter accepts me, etc. And encouraging words by my friends that I “would surely get in” did little to comfort me. I thought that the future was *genuinely* open about my going to Japan. I take open future to mean that the future state of affairs in the world is not fixed. I call this the strong sense of future openness. If it should be the case, that future is not open in this strong sense, but it should be the case that open future can be constructed in some other way, then I will call this other option the weak sense of open future.

Secondly, the notion of open future seems to stand in clear conflict with our best theory of space time (ST), namely the 4D universe theory, and it would be preferable if we could resolve the conflict somehow.

Finally, to my surprise, it seems that the question of open future in 4D universe is not that well researched yet. My literature search on EBSCO, SCOPUS, web of science, and Google Scholar, managed to identify barely any previous literature on the matter. Therefore, I hope that my thesis can offer a valuable contribution to the topic.

In the following, I will introduce theories from different philosophers who have argued either for or against open future in a 4D universe, and assess them. In chapter 1, I will begin by explaining 4D universe, and will offer a very common defence for the correctness of 4D theory. In chapter 2, I will introduce theories that seek to accommodate open future in an indeterminist ST. This is usually taken to mean the branching worlds` theories, and therefore I will also limit myself to theories of branching worlds in this chapter. I will enquire what it means for the future to be open in such a world. Also, the question if branching world theories are indeterminist after all, will be posed. In the third chapter, I will look into determinist accounts of open future in 4D universe, to assess if we can have open future without invoking branching. I will conclude that it is possible to conciliate open future with 4D if we take the right perspective on the universe, causal relations, and our role in it.

2. WHAT IS TIME?

In this chapter, I will give a general background to my research questions, and talk about the relevant topics in metaphysics of time. I will go over A-theories and B-theories of time, the debate between eternalism and presentism. I will also introduce the notion of temporal flow.

The usual way of thinking about time can be called presentism. Presentism holds that only what is present now, exists. So, when a person is asked to write down all the things that exist in the world, she will write down e.g. University of Tartu or Japan, but not dinosaurs nor future outposts on Mars (even if there will ever be any). This is so, because for presentists, only currently existing objects are real.

Additionally, since things happen in time and it seems that we can make true claims about the events that are, have or will take place in time, we might think that time has certain properties. We can say *presently, I am writing this paper* or *two days ago I had a Japanese class*. We might think that these sentences are either true or false, because of some temporal properties, such as presentness, pastness and futurity, make these claims true or false.

Similarly, we might think that there is a fundamental difference in saying that (i) *I played badminton yesterday* or (ii) *I'm playing badminton now*. We might think that *if* I am playing badminton now (and suppose I'm playing it for the first time), then (i) is true, but (ii) is false. However, by tomorrow (when I am not playing badminton), (i) has become false and (ii) has become true. In other words, we might think that the truthiness of a sentence can change depending on the time of its utterance.

This is what A-theorists about time believe. They believe that tense in a sentence expresses a metaphysical fact about the nature of time. A-theory of time stands in opposition to the B-theory of time. The first philosopher to draw a distinction between two different series of time was McTaggart (2003). He distinguished between the A- and B-series of time. The A-series, orders events in terms of their pastness, presentness, and futurity. Events constantly become from future (to near future) to present to past (to further past). In terms of B-series, however, time, or temporal locations, are static and the temporal properties of events are not subject to change (at least in this sense). In terms of B-series, events are by dates and times they happen. If X happened in May 15th 2019, then it always will be the case that it happened in May 15th 2019, and this fact is not subject to change.

Now, A-theorists believe that the A-series is not reducible to B-series (and the B-theorists in the objective now and the objective flow of time. According to the A-theory, time is tensed in the sense that *I played badminton yesterday* and *I will play badminton today* are two inherently different sentences. Therefore, facts are inherently tensed for the A-theorist. (i) *as of now*, is a

true fact about the state of the world (if you have played badminton), whereas (ii) isn't (you are reading this thesis).

According to the B-theory of time, on the other hand, time consists of ordered sequences, and ordered sequences only, connected to each other via temporal relations. For the B-theorist then, the truth-makers of A-theoretic sentences are B-theoretic sentences. For the B-theorist, (i) and (ii) are incomplete, both just express *I play badminton at time X*. Completing them means providing the sentences with B-theoretic facts, such that (i*) *I played badminton at 15.05.2019*; (ii*) *I'm playing badminton at time 15.05.2019*. However, if you played badminton at 15.05.2019, then it will always be the case that you did so. Truth-values of B-theoretic sentences are not subject to change. Both of these sentences express the same meaning¹. The disagreement over tense is often expressed in the following way: A-theorists take tense seriously, whereas B-theorists don't.

On a related note, when thinking about time, we might imagine ourselves as being immersed in something that flows past us, or that floats us ahead like a log in a stream; we might also imagine ourselves somehow persisting in time, and moving forward in it, just like a ship sailing on a sea towards the unknown. If we think about time like this, then we are believers in temporal flow, or, alternatively, we believe that time is dynamic, that it genuinely changes

What is time then? We tend to think that a crucial aspect of time is change, and we might take change to mean some kind of a dynamic event in the state of the world. *If* there indeed is some kind of a dynamic change in the world, then whatever account of time we end up having, we want to keep the account accommodative with this notion of change. We saw previously that A-theory can accommodate change quite well. In case of B-theory, on the other hand, dynamic change might become problematic. The B-theory only allows you to think of time in static terms: if you play badminton at some time t_2 after some event Q at time t_1 and before some event R at t_3 , then it will always be the case that the event P occurs after Q and before R, this cannot change. The A theorist will of course agree to the fact that Q is temporally earlier than P, but the A theorist would argue that in addition to this, there is something else, namely that events *themselves* change or become past events from present events, and that this change is fundamental to the nature of the world. Further, a presentist, relying on A theory, takes the argument event further and maintains that not only was there some kind of a genuine dynamic

¹ Of course, not necessarily. It depends on which B-theoretic facts *now* and *yesterday* refer to.

change, but that there was also ontological change to the state of affairs in the world, or, alternatively, the furniture of the world. Namely, that *if* Q is temporally earlier than P and P is the case now, then Q doesn't exist anymore, i.e event of Q is not anymore counted amongst the state of affairs in the world.

Here, we need to make a little detour to help shed light on the exact difference I want to draw between presentism and eternalism, and what I mean by the verb *exist*.

Firstly, there are two slightly different notions of the everyday word *exist*. On the one hand there is the basic logical quantifier, known as existential quantifier. In general the existential quantifier corresponds to our everyday uses of *there is*. The quantifier does not range over impossible and purely fictional entities such as unicorns or Santa Claus. This is the quantificational perspective on existence. From this standpoint, the quantificational presentist will deny that the atomic quantifier ranges over past and future entities, such as dinosaurs or future human outposts on Mars (if there will ever be any).

One way of drawing out the difference between presentism and eternalism in terms of quantificational sense of *exist* has been offered by Sider (2006):

Take the sentence

(*) Dinosaurs once existed

Now, both presentists and eternalists would agree that (*) is correct. But they disagree over what makes it true. For the eternalist, the claim is made true by claims that quantify over past and future. So, for the eternalist (*) means:

(*_E) There exist dinosaurs, located temporally before us.

$\exists x(Dx \& Bxu)$

The presentist, however, cannot agree to such a claim, since nothing that is located temporally before (or after us) exists for her. For her, sentences like (*) involve primitive, unanalyzable tense operators that make the sentence true. So, for the presentist, (*) expresses:

(*_P) It was the case that: there exist dinosaurs

$P\exists xDx$

Where P symbolises the past tense operator (*it was the case that*).

But the notion I am more interested in is ontological existence. Ontologically speaking, it is usually held that there is only one non-derivative, unqualified notion of existence. We can call it existence *simpliciter*, or, E, for convenience's sake. This means everything that is included in the furniture of the world. The dividing line between presentists and eternalists then is the question of what falls under E. An ontological eternalist would argue that present, past and future events fall under E, whilst a presentist would disagree. According to the presentist, wholly future and wholly past events are not included in E. When talking about existence, in this thesis, I will have in mind this ontological notion of existence *simpliciter* (unless specified otherwise).

To make the idea clearer, consider an example by Frances (2016): suppose you are blowing soap bubbles and one of them pops. This seems to mark two kinds of change in the world: temporal and ontological. Temporal change means change of temporal presence – the soap bubble was temporally present before it popped, and not after it popped. Ontological change would be change in the furniture of the world, or E. The bubble was included in E before popping, and if there was any ontological change, then after popping, the bubble wouldn't be included in E anymore. Now, the presentist would argue that this kind of an ontological change did take place when the bubble popped, whilst the eternalist would deny that.

Let's return to A theory. It has often enough been argued that A-theory leads to a contradiction (e.g. MacCall (1976); McTaggart (2003); Smith (2011)). I will not go deep into this debate, since the focus of my thesis is on eternalism, and thus I must already assume that B-theory is correct, and the A theory is not (for my definition of eternalism, see 2.1.). But I will say a few introductory words about the debate to give some context.

The first philosopher to point out a possible contradiction in the A series of time was McTaggart. He distinguished between A-series and B-series of time. McTaggart held that that only A-series can accommodate genuine change (which in turn for McTaggart is a precondition for the existence of time). But since A-series are contradictory, then time is unreal. Here is a very brief demonstration of McTaggart's argument

- (i) A-theoretic events change from objective future to present to past
- (ii) Each event in A-series has a temporal property of pastness, presentness or futurity;

- (iii) These properties are mutually exclusive: no event can have the property of being present of past at the same time;
- (iv) (from (i) and (iii)) If events change from objective future to present to past, their temporal properties of events must also change;
- (v) Then we need A-theoretic time to explain the change in temporal properties of events
- (vi) But (v) is circular (we need A-theory to explain A-theory), and therefore cannot correct.

There are those who argue, that McTaggart has not convincingly proved that A-theory does in fact lead to a contradiction, and we should accept the A-theory (e.g. Spolaore & Gallina (2018)), however, there are others who argue that A-theory is nevertheless implausible (e.g. Sider 2001) and ought to be rejected. The general philosophical consensus seems to be that attempts at saving A-theory have not been satisfactory.

Further, this notion of genuine change is inherently linked with the idea of temporal flow, the idea that time somehow moves. MacTaggart himself, for example, was certain that only the A-series can accommodate genuine change. So, here is another way to draw out the problem as offered by Skow (2015). For something to move, we need three things: (i) an X that is moving, (ii) a dimension in which X moves, and (iii) a dimension with respect to which X moves. Suppose X is an ordinary object, say a car. Then (i) the car moves if its (ii) spatial location changes with respect to (iii) temporal dimension (time). But then what does it mean to say that time changes? Say, (i) X is time. But what are (ii) and (iii)? Some have argued that time moves with respect to some (iii) supertime (a possibility which Skow dismisses), but there seems to be no (ii) dimension in which time can move.

I will not go deep into this, since, as I mentioned, this falls out of the focus of this thesis, and I already suppose that A-theory is false. In this chapter, I attempted to give an overview of relevant topics in time with respect to my research questions. In the next chapter, I will proceed with eternalism and will bring forth one of the most common arguments in favour of eternalism, i.e. the argument from general relativity.

2.1. Eternalism

In this chapter, I will introduce the notion of eternalism, and offer a very common defence for eternalism that seems to rule out presentism. This is the argument from general relativity. I will also attempt to give an account to our intuitions of temporal flow. I will argue that these intuitions are false, but we have them because they have been fitness enhancing in our natural history.

One might think that there's more to say about time than just the properties-talk. Following Smith (2011), we can distinguish between three different accounts of time: nowism (only what is now exists), now-and-then-ism (everything what was in the past, and what is now exist) and eternalism (everything what has been, is, or will be exists).

Further, when these three accounts of time are conjoined with A or B-theory, we get four different theories of time:

- (i) *The Block universe*: eternalism + B-theory;
- (ii) *The Moving Spotlight*: eternalism + A-theory;
- (iii) *The presentist view*: nowism + A-theory;
- (iv) *The growing block theory*: now-and-then-ism + A-theory.

Smith's use of *eternalism* is a bit different from mine. I am interested in (i), and my use of the term *eternalism* corresponds to Smith's *block universe*. Theories (ii) to (iv) fall out of my interest. Below, I will bring forth a very common defence for eternalism, that is generally thought to rule out presentism in favour of eternalism. For an in-depth overview of why the other theories of time fail, see Sider (2001), for a comprehensive overview, see Smith (2011).

With that said, let us proceed with eternalism or the block universe. I will treat four-dimensionalism (4D), and eternalism as synonymous with the block universe. Though some (e.g. Smith) make a distinction between these terms, so that eternalism could be a building block for the block universe and moving spotlight view, then whenever I use the word eternalism below, I will only have in mind eternalism conjoined with B-theory.

Nevertheless, since I will not be talking about other models of time in this thesis, I think it not too big of a transgression to ignore the subtle differences, and treat the terms synonymously. What I mean by eternalism (or the block theory, or 4D) is a ST where everything in the past, present and future exists on a par. A ST like that is occupied by events and continuants. Events

such as playing badminton, dancing, flights etc, are things that happen or are performed in the world, whilst continuants are objects or subjects, such as tables, animals, street posts etc, that persist through time. Time, then, is a dimension along which these events and continuants extend. An eternalist is a proponent of a ST with three spatial dimensions and one temporal dimension. So, as long as we are talking about existence *simpliciter*, Napoleon exists, just like you and I do and just the same as future human colonies on Mars exist (if there will ever be any, that is).

It is important to stress that the block is throughout static. Dynamic change as we usually think of it does not occur. Change in this universe happens by virtue of objects' instantiating different properties in different temporal locations.

2.1.1. Einstein's good idea

By now, one might be wondering, if we have any positive reasons to believe that the eternalist picture of ST is the correct one.

In fact, we have plenty. In what follows, I will outline the most common argument in favour of eternalism: it is the only theory of time that accommodates Einstein's theory of relativity.

But first, consider again the A-theories of time. For A-theorists *now* is substantially meaningful. There is something special about *now*, namely it marks everything that exists. This substantiality in turn, implies absolute simultaneity: everything that exists *now*, exists in the same time, independent of any observers. But this idea is not supported by the principle of relativity, according to which simultaneity depends on the observer's frame of reference.

To see this, let's follow a famous though experiment in the fashion of Lockwood (2005): Alice is sitting in the train reading her newspaper and the train is moving at constant speed X towards a station. Then, suddenly, lightning strikes in from the cabin window catching her attention. Suppose further that there are three mirrors in the cabin, one opposing the window and one at each end of the cabin. Finally, suppose that Bob is sitting on the top of a hill, watching the train pass him by and he also sees the lightning striking through the window.

Alice and Bob will see the order at which the lightning strikes the mirrors differently (see figure 1). As Alice witnesses the event, depicted in the picture (A), lightning will strike mirrors B and C simultaneously and then the two rays hit into the mirror D simultaneously. Whilst Bob will

agree that the light reflected from mirrors hit the mirror D simultaneously, he will disagree about mirrors A and B. The way she sees it, is that lighting struck into mirror B before C. This is because relative to Bob's frame of reference, Alice's frame of reference is accelerated and the mirror B moves toward the lighting strike, whereas the mirror C moves away from it. The lighting then takes less time to hit the former but has to catch up with the latter. Whereas from Alice's frame of reference, the cabin is at rest and mirrors are not in motion relative to the lighting, and therefore, assuming that mirrors B and C are at equal distance from the window, will strike them at the same time.

This is because, assuming the principle of relativity, sameness of place is an irreducibly frame-dependent notion (Lockwood, 2005). Frames, or frames-of-references, are theoretical constructs in physics. They are used to measure the position and motion of any two or more objects or events in relation to each other. Now, what the above thought experiment sought to show is that there is no frame-independent simultaneity that would constitute one single *now* or *present*. That is, neither Alice's nor Bob's experience is objectively more correct than the other. If we take *present* or *now* to be the objective limits of what exists, then it follows that, objectively speaking, all events are equally real and in existence, because what exists presently, is frame-dependent. But then, *now* and *present* are reduced to nothing more than temporal indices, that mark the temporal point we are talking about, just like *here* is a special index and *I* a personal index. It is always trivially true that *I am here now*.

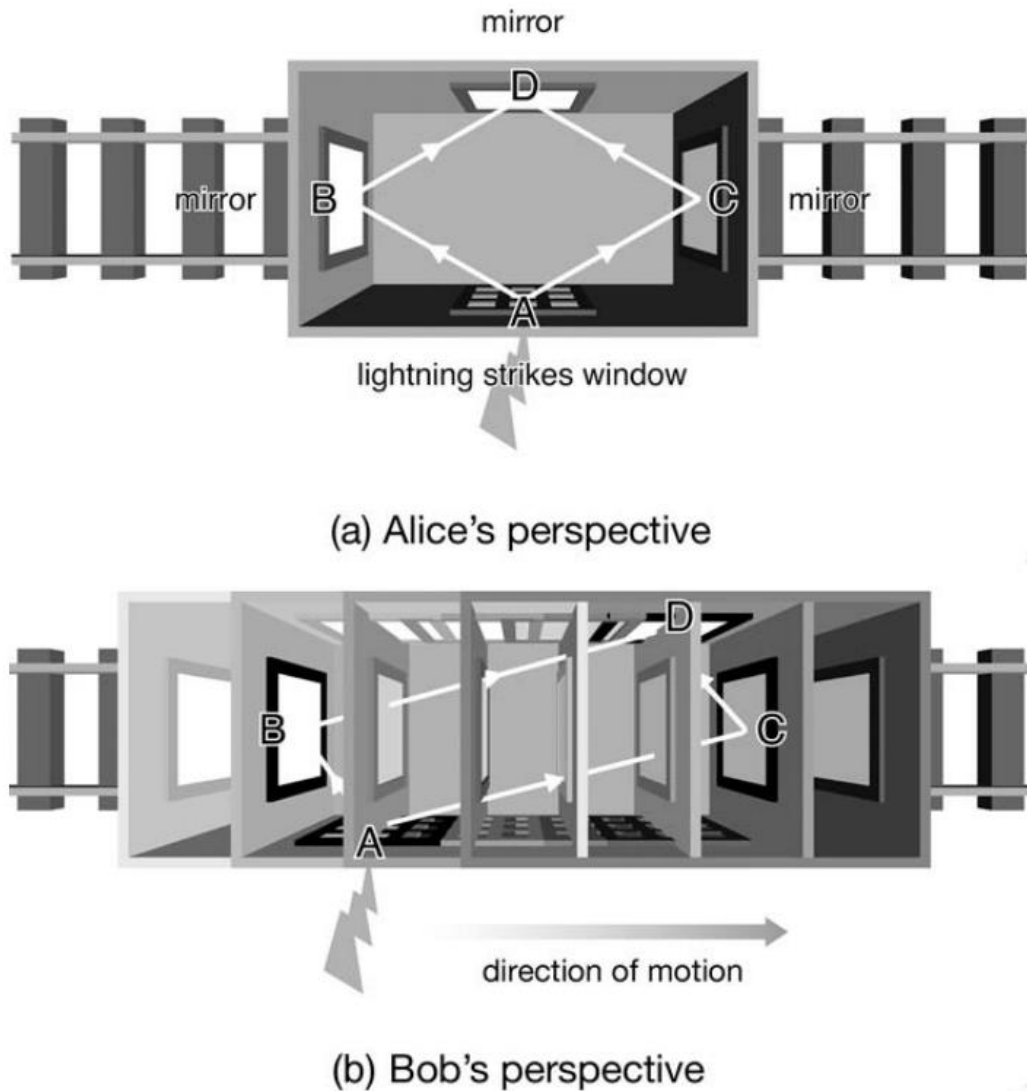


Figure 1. Two perspectives. From (Lockwood, 2005)

2.2. Why do we perceive time as dynamic?

Intuitively, of course, a static block universe feels wrong. Very wrong. Intuitively, sentences like *pterosaurs exist* (in the sense of exist *simpliciter* as discussed earlier) are absurd. We tend to think that there is something special about the present and, moreover, we, who are alive presently, are somehow privileged over the contemporaries of Napoleon, and pterosaurs who fell under E in the past but do not fall under E anymore – we exist, whereas they do not. And because of this, we tend to think that some things have genuinely gone out of existence (whereas other things have genuinely come to existence), from the time of dinosaurs, or of Napoleon.

Further, intuitively we might take change to be necessarily dynamic, and the idea of eternalism might even seem absurd to us, at first. If we compare these intuitions² with our intuitions about what is going to happen in the stock market (even if we're economists) next week, we see how strong these intuitions are. It might take a lot of philosophy classes to subdue these intuitions.

Why then do we have such strong intuitions about time that are completely off? Surely, it cannot be a coincidence that almost everybody just happens to experience time more or less exactly the same way? An in-depth analysis of the nature of time and its consequences to human behaviour should probably go over this problem. Of course, perception of time and temporal experience is in itself a deep research topic, and I wish to not go into it too much, so I will not delve into the classical questions of what is temporal experience, and if we can really *perceive* time. My intentions are much humbler here. I wish to only say a few introductory words about the topic, and offer one explanation, that to me seems to make the most sense.

Philosophical problems of temporal experience are many and complex, so here I will limit my focus on only two aspects, that are most important in the context of the thesis: (i) why do we experience temporal flow, and (ii) why do we experience temporal asymmetry?

We do have motivations to think that evolutionary explanations underlie these questions. For one, we know that temporal experience is related to how our brains work. For example, people with prefrontal damage may find it difficult to keep up with deadlines and time management in general (Fogel & Greenberg, 2015). We also know that temporal cognition is closely related to spatial cognition, making it plausible that at some point in our evolutionary history, the cognitive apparatus that was evolved for dealing with motion, was also adapted for dealing with time (Prosser, 2016).

Because of this, Dyke and Bardon (2013) have argued that temporal experience is an evolutionary adaption that has been especially advantageous to our survival. Traits that are advantageous for survival and reproductive success (that maximise the likelihood of survival and reproduction), are in evolutionary biology called fitness enhancing traits.

Beliefs that result in a distorted representation of reality can sometimes be adaptive if these beliefs motivate fitness-enhancing behaviours (Wilson, 1990). Wilson calls these kinds of beliefs Adaptive Imaginary Representations (AIRs). AIRs are produced by processes that are

² I take intuitions, folks beliefs, and common sense knowledge as synonyms, there might be subtle differences between them, but these differences are not important for the purposes of this thesis.

known as off-tracks. Off-track processes are processes that produce beliefs that are untrue (Kahane, 2011). A very typical examples of AIRs are religious beliefs.

One might be tempted to think that all folk beliefs are AIRs, as our commonsense knowledge, heuristics and biases routinely lead us astray and produce false beliefs about the state of the world. However, it is important to stress that, our mental faculties have evolved to maximise the accuracy of our perception in the world, therefore it is not obvious that all or even most folk beliefs are AIRs Dyke and Maclaurin (2013).

Nevertheless, it is probable that to be right has not been fitness enhancing in every situation every time in our natural history, and there has been a trade-off between correctness of our beliefs and their usefulness for survival. If this is so, and if the beliefs in time flow and temporal asymmetry are mistaken intuitions, as they very much seem to be (as we witnessed in the last chapter), then it is probable that these intuitions are AIRs – incorrect, but useful.

It is easy to see why beliefs in temporal asymmetry might have been fitness enhancing: the ability to recognise danger, and act on it, is a clear evolutionary advantage for anyone over someone with more passive, fatalist beliefs about the world. This explanation is further corroborated by psychological findings that we tend to be more attentive to dangers in the immediate future compared to dangers in the distant future Dyke and Maclaurin (2013)

The evolutionary advantages of perceiving time as flowing, are not that clear, however. (Falk, 2003) has argued that such experience is an evolutionary by-product, or spandrel, of keeping events temporally organised in our long-term memory. However, the existence of spandrels is controversial (see e.g. Dennett's counterargument to spandrels in Dennett (1995)), and the term generally seems to recall the use of *dysfunctional* amongst the functionalists in 20th century sociology – a convenience term used for the lack of any theoretical explanation of the observed phenomenon. Therefore, we would do better if we could find a theoretical explanation for the perception of temporal flow.

Luckily, Prosser (2011) has offered a better explanation for the experience of temporal flow. According to Prosser, we experience temporal flow, because it has been more advantageous for us to understand objects as enduring, rather than perduring over time. It has certainly been fitness enhancing to not just realise danger, but that *I am* in danger (as opposed to my future counterpart, who strictly-speaking is not me at all).

Yet we know that none of these intuitions are correct, since they conflict with the static Eternalist account with the world. Therefore, I argue that the experience of time as flowing and as asymmetrical are AIRs – they are useful albeit incorrect. In conclusion, if my assumption, that there has been a trade-off between true and useful beliefs in common knowledge, then it is probable that temporal beliefs, at least the two that I am concerned with here, have been evolved for the “useful” part, and cannot be taken too seriously in philosophical argumentation.

2.3. Problem of open future

One of the many unintuitive implications about 4D ST is that the future exists on a par with the present (and past). This means that there is no question about the state of affairs in the future: if it *will* be the case that there are human outposts on Mars at time *t* in the future, the furniture of the world already *is* such that there are human outposts on Mars at *t*. If it is the case that somebody is reading these lines at present time, then already at the time of dinosaurs it was the case that somebody is reading these lines here at the present time (remember, *present* is but an indexical).

Of course, this (again) runs contrary to our folk beliefs about the future. When we talk about the open future, we usually assume some kind of asymmetry between the past and the future. We have already touched upon the notion of temporal asymmetry, but for convenience’s sake, let’s define it again. The asymmetry in short is this: the past is in some sense fixed whilst the future is in some sense unfixed. There are two different kinds of temporal asymmetries: practical or metaphysical and epistemic asymmetry. Epistemic asymmetry is concerned with our knowledge about the past and the future, and therefore is not about the actual state of the world. Because of this, we are not too interested in the epistemic asymmetry in this thesis. On the other hand, practical asymmetry is not concerned with what *we can be* certain about in the state of affairs in the world, but what *is certain* about the state of affairs in the world. This asymmetry is interesting for us considering our purposes, and therefore from now on, we will use the notion *temporal asymmetry* synonymously with the word pair *practical asymmetry*.

Physics of the last century has shown us that there is no fundamental temporal asymmetry in the actual state of affairs in the world (Ismael (2016); Lockwood (2005); Sider (2001)) – either there are temporal uncertainties in both the future and past, or there are no temporal uncertainties in neither the future nor the past. What does this mean for our intuitions? Are our

intuitions about the open future as false as our intuitions of temporal flow? We want to think that the future is open, that it is not yet certain if there will be any human outposts on Mars, and we also want to keep thinking that future is in some sense fixed – you either played badminton yesterday or you didn't, there is no changing it. Once we accept eternalism, it seems that there is no good way out – we have to give up one of these intuitions, and either accept that both the past and future are open, or both are fixed and there is no changing of what is to come for you. Or is there a way out? The remainder of this thesis will look into these questions.

3. OPEN FUTURE AND INDETERMINACY?

This chapter is an introductory chapter for chapter 4. In this chapter, I will introduce a common argument that is used to motivate the talk of branching time theory. It seems to be generally held that indeterminacy leads to rejecting bivalence and one way of tackling this problem is accepting branching times. In this chapter, I will not present my own views, and, in fact, will attempt to show in 4.3. that this line of argument is misleading, as branching ST does not only not assume indeterminism, but is in fact at odds with indeterminism.

Determinism is the idea that future is in some sense fixed, whilst indeterminism is the idea that future is in some sense unfixed. It is easy to see where the problem of open future lies when one assumes determinism to underlie ST: if the future is determined, then it is already fixed that whatever will happen at a future point t , actually does happen at t . But then, it can be argued, the future is anything but open – there is no choice as to whether an event x happens or not, it is already decided which. We will look into the question of whether or not this stance is justified, in more detail in chapters 4 and 5. Let's first explore indeterminacy.

At first glance, it might seem that in the indeterminist ST, the question of open future either is not that problematic or that there is nothing to raise concerns about at all: since the world is undetermined, there are no laws fixing future, and thus the future is just trivially open. Because of this, at first glance, it might seem that the problem we need to tackle within the indeterminist framework is a bit different. In fact, it is often thought that indeterminism requires us to sacrifice the principle of bivalence (Barnes and Cameron (2011); Markosian: 1995); Torre, 2011)), that it is always the case that either p or $\sim p$, because there is nothing to fix the truth or falsity of q . Next, I will attempt to illustrate how the worry over bivalence might come about.

3.1. The problem of future contingency

It has been argued that at the heart of a debate surrounding indeterminism lies the problem of future contingents Spolaore and Gallina (2018). Let's take a familiar case for illustration, *e.g.* the version offered by Barnes and Cameron (2008):

- (1) Either it's true that there will be a space battle 2000 years from now or it's true that there won't be a space battle 2000 years from now.
- (2) If it's true that there will be a space battle 2000 years from now then it's true now that there will be a space battle 2000 years from now, and the opposite is true, if it's true that there won't be a space battle 2000 years from now.
- (3) If it's true now that there will be a space battle 2000 years from now, or true now that there won't be, then how the future is, is settled by how the present is³.
- (4) Therefore, how the future is, is settled by how the present is.

So, there either will be or will not be a space battle. Where does the problem lie? Let's designate whichever will be the case with p . But it seems plausible to assume that if p is true, it is true *simpliciter* because truth values about sentences are not subject to change. Therefore, if p will be the case in 2000 years from now, it is already true that p 2000 years from now. Therefore, p must be necessarily true. But if p is necessarily true, it cannot be possible that there are any other options but p . However, if we want open future we must be able to express something in the lines of $\diamond F(y)\sim p$ or, informally *it is possible that not- p* , whereas $\Box F(y)p$ that we have just arrived at above is just another way of expressing that $\sim\diamond F(y)\sim p$, or, informally, *not- p is not possible*.

However, our concern is not just whether space battles lie awaiting in a future that is open. The space battle is just an arbitrary event chosen for example's sake. And because of this, we can draw a final conclusion:

- (5) Since we were dealing with an arbitrary event at an arbitrary future time, how the future is in all respects is settled by how the present is.

³ I acknowledge that (3) is false. I also acknowledge that in an eternalist universe, indeterminacy wouldn't necessarily entail giving up bivalence. In fact, I think that using indeterminacy to motivate branching ST is completely misguided, and I will take this up in section 4.3. However, in this chapter I merely attempt to draw out what to me seems to be the usual way of motivating talk of branching ST.

This conclusion seems to obviously mark the end of any debate over open future, and with a bleak answer. But it seems so intuitive to think that whatever we have done has not been the only option for us at that time. On the one hand, when we ponder upon our future doings, we think of it as if it was open: *I wonder if I have time to play badminton this week*. And when we think like this, we don't usually mean: *My playing or not playing badminton sometime this week is actually already settled, I am just ignorant of this settledness*. You probably don't mean this as if it was settled already anyways, and you are just waiting to find it out. When you think that, you probably assume that your playing badminton is somehow genuinely open. The intuition comes about in another way, too. I'm sure that everyone has at least once in their lives found themselves thinking *if only I would've decided otherwise* or, in a more positive light, *I am so happy that I made exactly that decision and not any other*. When you think like that, you probably assume that there was some genuine openness in that moment that gave you the choice of doing exactly what you did. Otherwise these thoughts would be meaningless.

No matter our previously critical appraisal of intuitions concerning temporal intuitions, let's generously suppose that these thoughts have at least some sense of truth behind them. That is, suppose that our future is open in some sense. One way to interpret the thought is that $F(y)p \mid \sim F(y)p$ lack a truth-value, i.e. are indeterminate. This of course would mean rejecting bivalence.

Is there a way to save bivalence and still preserve open future? Let's take a second here to ponder upon time. Ordinarily, we consider time as a linear vector pointed towards future. If we are eternalists we think of this this linear vector in as one dimension in a "block" where specific states of affairs correspond to every time unit in that rectangle. Every time unit corresponds to exactly one event and this event is necessarily linked to the time unit.

But is this the only possible way to think of time? It might not be. For example, think of your past, say yesterday. Let us assume that you had an ice cream yesterday. But was you having ice cream really inevitable? Could you not have done otherwise? Maybe you had a choice yesterday evening to either have ice cream or go to the movies and you just happened to be keener on ice cream. Maybe you were indecisive and you tossed a coin to choose. You could've easily done both.

And maybe you did. From various science-fiction books and films etc. most of us are probably to some extent already familiar with non-linear timelines. In whatever way these alternating

timelines are portrayed, they all assume an indeterminist world where at any given time for any cause more than one effect is possible.

These alternating timelines might be exactly what we want. Now, if we try to model alternating timelines, then instead of one linear timeline we end up with a bunch of different possible historical chronicles that accompany any cause in any point in time. In such an indeterminist ST, we do not that much speak of a 4D block, but rather of a 4D tree which has innumerable branches branching off it at any possible ST point. Let us now take a look into what can be called the branching time model and how we could fit it into the 4D block.

4. BRANCHING TIME

In this chapter, I will offer one possible account of open future. I will argue that we can have open future if we are willing to accept branching times into our metaphysics. I will also defend the theory against some counterarguments and will draw out three ways of how we could possibly inhabit a branching ST.

One common view of open future is known as the theory of branching time (BT). According to standard theory of BT there are many futures, but only one past (but also see (Farr, 2012) argument for the open past). Since the branching time theory is usually taken to imply the objective change of present, the branching time theory can be said to imply either presentism or the growing block theory. This means that branching time theorists reject reductionism about tense. However, branching time can easily be constructed in a B-theoretic framework.

Figure 2 offers a visual representation of branching. Here, h means different histories that branch off, m are moments in these histories, and i are instants, also called times in literature, of simultaneous moments in different histories.

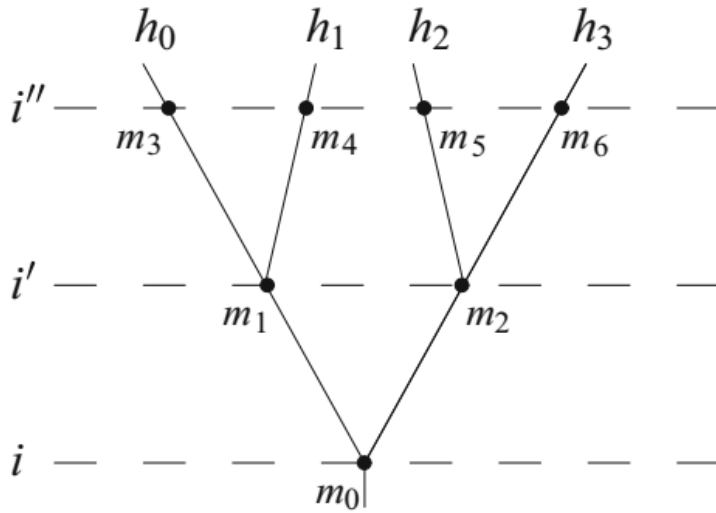


Figure 2. A partial representation of BU. From (Spolaore & Gallina, 2018))

One might be tempted to ask what these histories are. Histories can also be called chronicles or simply branches, and in the end of the last section I hinted at ST branches shooting off from a common point. But this is not the only interpretation. Benovsky (2013) has drawn a distinction between three different possibilities. The branching histories can either be:

- (i) Time
- (ii) Space-time
- (iii) Possible worlds

The first option seems puzzling, as Benovsky also acknowledges. It is unclear how time can branch off from ST independent of space and he does not give any justifications for this view. Therefore, I will discard (i) as a genuine possibility, and will not be talking about it further in the thesis. The second and third possibility remain. The difference between the two is that (ii) sees ST as one whole, with various branches, whereas (iii) sees branches as separate possible worlds. (ii) allows for timeline intersection, whilst (iii) denies them. For (ii) as the branches are offshoots from a common beginning, all the branches are actual; for (iii) only one world is actual. The third option has mainly been developed by Lewis (1986), and seems to run into some trouble analogous to the thin red line (TLR) account of branching. I will resume to it more

specifically when I take up the TLR. Therefore, unless specified otherwise, when talking about BT I will have in mind branching ST (BST).

In addition to that, branching time is also often thought to imply indeterminacy (Spolaore & Gallina, 2018). So, one account of branching time theory is such that:

- (i) P will be true if and only if it will be the case that P in every possible future;
- (ii) P will be false if and only if it will be the case that non- P in every possible future, and
- (iii) P will be indeterminate if and only if P will be the case in some future branches and non- P will be the case in other future branches.

We are primarily interested in (iii). This might require some further thought. First, what does it mean that p will be indetermined? There are at different types of indeterminism to account for here: is the truthiness or falsity of p epistemologically, semantically or metaphysically indetermined? Some may argue that the question of open future only becomes possible when we are discussing the latter, metaphysical sort of indeterminacy. In this case we are talking about indeterminacy in the actual world, as opposed to just being clueless about the truthiness of falsity of P (which is the case with epistemological indeterminacy. Secondly, does this mean failure of bivalence? Often, it is thought that we must sacrifice bivalence if we want to have a branching world.

We will be looking into these arguments shortly. In any case, one might be tempted to think that (iii) leaves the future open.

4.1. Branching world inhabitants

If we really do live in an indeterminist ST, how then do we occupy it? In a 4D universe it is sensible to assume that we extend through time. That is, we are not wholly present in any moment that we happen to occupy but in one way or another we perdure (see Sider (2001), chapter 5 on why perdurance is the best theory of persistence) in the block.

There are two ways to do that. We can be either ST worms, extending in time just like a road extends in space, different temporal slices of us occupying different ST points, again just like different slices of a road occupy different points in space, or we can inhabit the block (or more exactly, the tree) in virtue of having a countless number of temporal counterparts, or stages, in every ST point that we exist. These temporal counterparts are connected to each other via what

Sider (2001) calls the genidentity relation. Genidentity is a relation between two stages that holds if and only if the stages are spatiotemporally connected. The two accounts differ in what constitutes you. The general difference between the two is that according to the worm-theory the sum of all the temporal parts constitutes a person, so what makes you *you* are all your temporal slices as well as branched off slices. For the stage theorist, what constitutes you is you and that's it. The future, past and branched off persons in different histories are your counterparts connected to you via shared memory of somatic properties or whatever you think makes up the genidentity relation. You can also take the relation as primitive, if you wish.

One might think that the worm-theory perspective is too strange and departs too heavily from our general intuitions about personal identity to be acceptable. Luckily, an additional third possibility seems to emerge within the context of the branching universe theory. This is a second possible account of the worm theory. According to this, you occupy only one history and share a common history, or branch, with your worm-counterparts, who branch off from you. The difference is that in the first case you can occupy different moments in different histories at the same instant, whereas in the second case this claim is wrong – you can only occupy one moment and only one history at each instant, but there can be other moments in other instants that are occupied by your worm-counterparts.

For the purposes of this thesis, it is not particularly important which of these accounts is correct. Both have their ups and downs. When it comes to branching time, the counterpart theory might seem more intuitive. It also has the upper hand when dealing with coinciding objects. Whereas some of the advantages of worm theory are that it does not violate the Leibnitz law and it can accommodate our talk of timeless counting. Sider gives the example of *fewer than two trillion persons have set foot in North America throughout history* – a sentence that, though it certainly seems to be true, becomes false under counterpart theorists' reading.

To me, it seems that the worm-theorist's perspective is the more sensible one, but it as I said, what is relevant for the thesis is if there is at least one satisfactory theory to accommodate us in the branching ST. If there's many – there more the merrier. The question which of these is the best one falls outside of the scope of this thesis. The take-home message is that inhabitants of branching 4D inhabit ST essentially the same way as inhabitants of any 4D block plus one extra option.

4.2. Counterarguments to BST

So far, I have tried to show how we can accommodate open future in the 4D space time via branching. Provided, we have made some progress. But some progress is not good enough. We might also have reasons to doubt this theory of ST. In this section I will see some of the objections that have been made against BST, and will defend the theory where I see fit. I will start from what I think are the weakest objections to BST, and then proceed to the stronger ones.

4.2.1. Critique from morality

A puzzling critique of BST is the critique from morality, offered by Barnes & Cameron (2011). In short, the critique is as follows: in a static BST we have no reasons to be moral – if there will be a space battle in any branch of the world, then it already is the case that the space battle takes place at that future branch point. My reasons for avoiding ending up in that branch then can be only selfish, but not moral. Since our branching block is static and eternal, all possible branches exist on a par, and there is no way to genuinely avoid the space battle. I can only avoid ending up in that branch myself. But then there is not point to strive for morally good behaviour.

I will not go deep into all the flaws that I find in this argument, since the relevance of this sort of reasoning escapes me completely. There are two main reasons why I cannot understand its relevance. Firstly, while it is true that static branching universe might make us all immoral people (although it might also depend on how we inhabit BST), then it is clear why that might be a problem for our peace of mind (we generally want to be good), but it is not clear at all why this should be a problem for the world itself. Bad things happen in the world all the time, it doesn't matter whether the world branches or not. Some of it is our doing, some of it is not. Some is intentional, some are unintended consequences of our actions, we are aware of some of the bad stuff, unaware of others, and so on and so forth. Saying that these bad things are immoral, does not make them go away. But arguing against branching time from morality is just arguing that branching cannot be possible, because if it were, it would be very bad. A proper response to this is: "Well, tough luck."

The second reason I find this line of argument confusing is the notion of morality itself. It seems that in order to say that *blah* is bad, in any branch that we wish to avoid or end up in, we need a universal system of morality. Which we do not (yet seem to) have. Instead, we have a plethora of different moral systems, which offer different moral evaluations of the same events. Compare

what virtue theory has to say about Jesus to Nietzsche's assessment of Christianity, for example. Things that are absolutely detestable for Kantians might go perfectly fine with moral relativists and *vice versa*. And though it can plausibly be so that there is only one moral system that gets it right, it remains to be convincingly shown which. And here is where the critique from morality loses its ground completely – what does it even mean that an event in any branch is moral or not? As long as we don't have a definitive answer to this question, the critique remains mystical. For all we know, it might be the case that emotivists got it right, and there are no moral properties at all, so there is no problem to speak of.

4.2.2. Lewis' critique to BST

Probably the most famous objection to BST has been brought forward by David Lewis in his seminal *On the Plurality of Worlds* (1986). The general idea of the objection goes like this: see figure 2. Consider that at m_1 you are at crossroads, it's possible that, say, at m_4 you will be in a cinema, enjoying a good movie, and, say, that at m_3 you opted for having ice cream instead. But at m_1 what is about to happen is not yet settled in your mind. As far as you are concerned, anything can happen. Maybe you had a sore throat yesterday, or maybe the movie looks very promising but you are a little tight on money these days. In any case, looks like you're only considering your options at m_1 .

Remember that in the branching block, the "block" becomes a huge hunk of chronicles or time-worlds that intersect at some moments and branch off any point in time just like crossroads or streets in a city. It follows then that if you were to believe in branching worlds, your worry about whether you will be going seeing the film, or not, is not a real worry because there might not be one absolute answer. In different branches you will be doing different things and there is no one correct branch. You branch off to different histories of ST, all of them being equally real. So, you will go to the movies, and you will have ice cream too. But, as Lewis notes, this conclusion goes heavily against our everyday beliefs. When you ponder upon your tentative ice cream, you are not interested in whether you are going to have an ice cream *too* (at the same instant in a different history, that is). Here lies the problem: in our everyday intuitions about future, we assume that we have only *one* future, even if we do think of other possible branching futures, we take only one of them to be the real one, the one that *we* occupy.

Could we then argue, that though there might be many different branches, only one of them nevertheless is the actual one? This is the Thin Red Line (TRL) theory that I have withheld up to now. So, let's take a little detour and explore what it has to offer. One clear advantage point of TRL is that it allows us to accommodate BST in our everyday beliefs, and avoid the strange consequences of ourselves in the future – only one future is the genuine one, all others just “fall off” when the time comes (so to speak).

The downsides of TRL are however, that by avoiding one unwanted consequence, it opens the door for a ton of others. Given our 4D universe and our temporal counterparts that inhabit it, there is no sense to make of the idea that one of the branches is in any sense more actual than the others. Why not then? Because actuality in our case is just another indexical. Like *here*, or *now* it merely serves to mark the ST location of the speaker. Our temporal counterparts in other worlds exist just as we exist, it's just that they are not actual from our point of evaluation. Just like we are not actual from any one of their points of evaluation. But TRL requires more than that. The price of accepting TRL is accepting a genuine actuality. But what would that mean? What are all the other CPs doing that they exist non-actually? And if it is somehow possible, then what are the odds that we are the lucky ones who just happen to inhabit (and keep inhabiting) the only actual history? It's more probable that we exist, yet we are not actually historical? The problem is that there is no good explanation for this by the proponents of TRL.

Another criticism of TRL comes from MacFarlane (2007). He has argued that under scrutiny the TRL model fails to make any sense. To go over it briefly, the argument is as follows: according to the TRL model, one branch is privileged over the others. The one that is to become actual. But if only one branch of future (the one marked with the red line) is to become actual, the other branches are not genuine possibilities, as, *summa summarum*, they would have never become the future anyways. But then there is no actual open future, we just don't yet know what the future is going to be like. However, now this is just an epistemological issue. But we don't need branching times for epistemological indeterminacy to begin with!

But then again, Torre (2011) has objected to this counterargument. According to him, it does not follow from the fact that a branch *will* not be a continuation of history, that this branch *is* not a genuine possibility of how things might be. There might be something in this reply. We will return to this reply later in the next chapter.

Nevertheless, TRL model understood in such a way is not compatible with eternalism in our sense (remember that for us, eternalism strictly means the block universe theory, and we ignore the possibility of eternalism conjoined with A-theory a.k.a. the moving spotlight theory), as it requires A-theoretic time, and therefore falls out of our focus.

So, let's get back to Lewis's objection. How plausible is his objection? Essentially, the argument is that if branching universe is true, then our intuitions about future are very wrong. Many questions we pose and ideas we have about us (or anybody/anything else for the matter) in the future would turn out to be nonsensical – there is just no sense to make of the question “will blah be the case in the future?”, as the true answer to such questions would not be “yes” or “no”, but “of course, just like not-blah, shblah and mblah will be the case”.

Is that convincing? Not too much so, I would argue. I have two reasons for remaining sceptical. Firstly, whilst I agree that intuitions should not be completely thrown out of the window in our philosophical undertakings, then they definitely do not have any restrictive power *per se*. If an argument goes strongly against our intuitions, then we might have reasons to take it under scrutiny, but being at odds with intuitions cannot reject any philosophical argument by itself. We have already demonstrated how wrong our intuitions about time can be, and argued for an evolutionary trade-off between correctness and usefulness. It's much more useful to think in terms of one history, rather than a bunch of them: if a tiger makes a leap towards me and my firm conviction is that I will only get killed and eaten in this history, but I will keep on doing much more jolly things in many other histories, I am probably much less likely to run for my life than a believer of linear timeline. Further, I cannot see this intuition of a single future any stronger than the intuition of nowism. But then why should we take it any more seriously? Therefore, a proper reply to this argument therefore is just: so what? Our intuitions have been wrong before. This counterargument by Lewis is especially strange because it smells like a *tu quoque* – he is very quick to dismiss our intuitions about the realism of possible worlds.

My second point of contention is that it is not at all clear that adopting a BST perspective commits us to the kind of a plural-picture that Lewis suggests. As we had seen before, there are three possible ways for us to inhabit a BST, and only the first interpretation of the worm perspective is susceptible to this objection. For the worm-counterpart theory, and the stage theory the objection does not seem to apply. In case of the former, *you* are only one history, so you will not be doing different things in different branches. You only have different worm-

counterparts in different branches. So, the question becomes “which future branch will I be in?”, but this is nothing more than healthy epistemic indeterminacy about open future in BST.

In case of the latter, there is strictly speaking no *you* in the future, only future counterparts of you. But then the question of “Will I eat ice cream or go to the movies?” is nonsensical, because, strictly speaking, *you* don’t exist in the future. The objection doesn’t even rise. One can reword the question and ask: What will my future counterpart do in the future? But this question does not seem to be under a threat from Lewis’s argument. It seems a safe reply to say: “It depends, different temporal counterparts do different things”, just as it is safe to say that your different other-worldly counterparts do different things in the future.

4.2.3. Other counterarguments

Let’s now turn to more serious counterarguments to BST. Barnes and Cameron (2011) argue that static branching fails to accommodate open future, because all the futures that can happen are already actual, and there is no real choice between them.

Consider figure 3. t_1 is present and all other possible moments in history branch off from present. In a 4D block, some of these possible branches do not *become* actual, but all of these branches already *are* equally actual. It is just a matter of perspective, whether, say, branch t_2a is actual or possible. Here is how Barnes & Cameron build their argument: B-theoretic branching only allows us *talk* of open future but no genuine open future, as, from the viewpoint of t_1 , whatever happens in t_2a or t_2b , is already settled, and therefore not genuinely open. For Barnes and Cameron, then, genuine open future requires unsettledness, which they seem to understand as indeterminacy in the actual world, i.e. metaphysical indeterminacy. To make sense of this counterargument, and understand why I object to this, a fuller overview of their own theory is required, as well as some additional pieces of information that I discuss below. Since I will go into their own account in the next chapter, then I propose leaving this argument aside for the time being, and return to it in the next chapter when discussing Barnes’ and Cameron’s theory.

But Barnes and Cameron offer one more argument against BST. This one is more general and does not depend on their own account of the open future. This requires us to step back and look at the problem from the beginning – what do we really want to say when we utter that the future is open? That it is open *what* will happen? Surely, we want to say that, but Barnes and Cameron suggest that we also want to say that it is uncertain if *anything* will happen. Therefore, a

metaphysic that properly captures the notion of open future, must allow for the possibility that it is open whether I will have ice cream tomorrow, but also that it is open whether reality will continue tomorrow. And the argument is that the branching world theory fails to account for the last option.

How would a branching time theorist make sense of this? Consider figure 3. She obviously cannot just not draw a branch, because this would just mean that whatever was supposed to be happening in the undrawn branch is not on the table. She cannot erase the figure either, because what we are after is a possibility that reality in one history will stop to continue. It doesn't mean that ST stops to exist altogether. What she might try to do is draw an empty box and say that there are no space battles there, no ice creams. This would get her half-way through. But there is still *time* there. This is just a time branch with no objects in it. This certainly doesn't capture the notion we are after.

What she might try to do, as a final try, is to draw a box with an X in there. She would then argue that X means future nothing. But does that really make sense? Barnes and Cameron remain unconvinced. What would it mean? She argues that it is a branch where there's no time nor space anymore. I think it's fitting to call it the game-over-branch. But the game-over branch nevertheless still *is* a time branch. So what is this mystical time branch? It is very difficult to find a satisfying answer to this. It is the end of everything (within that branch), but yet it is a branch. We usually don't think of the end of reality as a still *GAME OVER* screen because this still screen still exists, what we want to say is that in that branch reality stops existing. And it seems like the BT fails to satisfy that expectation.

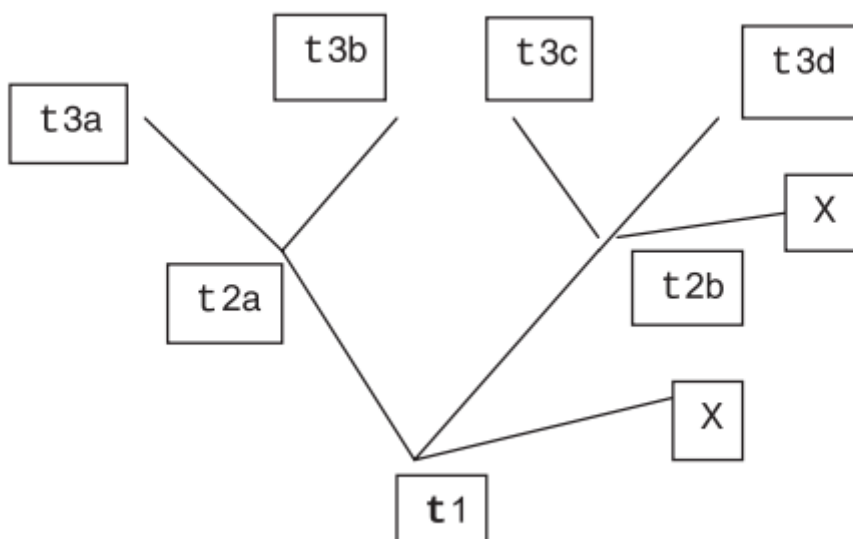


Figure 3. Trouble for BT. From Barnes & Cameron (2011)

There are two objections to this counterargument. A bad one and a good one. Let's first go over the bad one. One might object to this counterargument in the following fashion: "Okay, BT doesn't offer *that* future. Maybe then it's not possible for the reality to cease to exist in only one branch, and continue in others. But BT offers all kinds of other possible futures."

A quick response is this: we postulated open future to mean that it's open if $p|\sim p$. She seems to have something different in mind. She seems to be saying that for open future it's not always true that $p|\sim p$, but only sometimes. Expressed in a more sophisticated way, she seems to slip from $\forall x(Px|\sim Px)$ to $\exists x(Px|\sim Px)$. But then she better provides us with a list of special cases with explanations when and why $p|\sim p$ holds in these special cases and not in others. The burden of proof lays on her. Until she has done that, we have little to say of such an objection.

However, there is a better reply available: the figure is just a heuristic to represent different ways for the future to be. Now, we might not find a satisfactory symbol to designate the GAME OVER branch, but which ever symbol we adopt, in the end, is nothing more but a symbol. So, we can draw a box with an X in it, and agree that this means end-of-the-world-branch. There is nothing mystical about it. End of the world is just end of the world, and there is nothing more to say.

In conclusion, it is possible to accommodate open future with BST, assuming that BST is the correct picture of the world. However, of course, since we don't know if ST actually is branching, it would of course be better if we could find a way to preserve open future in a non-branching SP as well.

4.3. Branching and indeterminacy?

Finally, before closing this chapter, we have one more question to settle. I have knowingly ignored this up to now. Many philosophers have taken BST as an indeterministic theory about ST (Spolaore & Gallina (2018); Švarný (2015); Farr (2012)) or agreed that at least at first glance, branching universe seems to imply indeterminism (2013). Due to this I have presented branching as an indeterministic theory of ST. Nevertheless, many (Skow (2015); Barnes and Cameron (2011); Benovsky, 2013)) have argued against BST being indeterministic.

One might describe the general argument from indeterminacy to open future as follows:

If p will be the case in some future branches but not in others, then it is not possible to determine whether p is the case or not; however, if it's not possible to determine that, then p being the case must be left open, which, in other words, means that the future of p is open.

How plausible is this? So far, I have not drawn a precise distinction between open future and indeterminism, but the time is ripe to draw some limits. For one, open future is definitely not synonymous with indeterminism. Otherwise the question of open future in deterministic ST would be nonsensical (taken up in the next chapter). In addition, clearly, indeterminism is not sufficient for open future. You might see some straws of hay lying on the ground, and it is not clear if this constitutes a stack or not. This can be said to be a case of genuine metaphysical indeterminacy (e.g. Barnes claims that having just a few hairs on your head would constitute a case of metaphysically indeterminate baldness (Barnes & Cameron, 2009)), yet it has nothing to do with open future.

However, it might still be argued that open future is a special kind of indeterminacy. Namely, open future might be taken to mean *future indeterminacy* specifically. This is an argument that Skow (2015) proposes (but doesn't argue for it himself). Let's see where this road takes us.

Let's take a look back at figure 3. Suppose that you were considering to have ice cream or go to the movies at m_1 in the same instant, you had ice cream at m_3 , and went to the movies at m_4 .

You did neither at m_5 , because the thought never occurred to you at m_2 , and you get hit by a car and die in m_6 . So, in one instant (depending on your preferred way of inhabitation in the branch universe), either you or your counterparts eat ice cream, go to the movies, do nothing, or get hit by a car and die. But does that really mean that it undetermined at m_0 what is to become of you (or your future counterparts)? Not according to Skow. Skow argues that all we have shown is more determinacy. Remember, that we are speaking within the framework of eternalism here. All that was, is, or will ever be, already exists on a par. Then all the histories and moments in them also exist on a par. What we get is an overabundance of determinacy. It is not indeterminate whether you get ice cream or not. It is determinately true that you will have ice cream (right there, in history h_0 , at the moment m_3), just as it is determinately true that you will go to the movies. But surely more determinacy cannot lead to indeterminacy.

5. ANY OTHER NOTION OF OPEN FUTURE?

By now it has become clear that the branching universe theory is a good option to choose if we want to argue for open future. It certainly is attractive: it can accommodate different possibilities the future is going to be without sacrificing bivalence and do so in a more-or-less coherent way. If we are uncomfortable with indeterminism, then this might not turn out to be a setback at all: BST turns out to be a determinist theory, as we witnessed in the last section of the last chapter. However, one major setback of postulating open future in the context of BST is that we don't know if space time itself actually is branching. Therefore, we would probably be happy if we could find a safer route to preserve future openness in the eternalist block universe. For the remainder of this thesis, therefore, we will be looking into attempts at constructing open future in a deterministic eternalist universe.

5.1. Determinism

In this chapter I will discuss the possibility of open future without accepting BST into our metaphysics. I will argue that it is possible to construct such a notion of open future, but it would mean future openness in a very weak sense.

Before we can get to business, we need to define determinism somehow, to fully understand what we are talking about. Sadly, there is no one definition for determinism, and different philosophers have defined it in different ways, and of course not all definitions leave room for discussions about the open future. Here are some bad examples for my purposes:

- a. *To say, with regard to some time, t, that the future is open at t is to say that there are some propositions about the future relative to t that are, at t, neither true nor false. To say that the future is closed at t is to deny this, i.e., to say that every proposition about the future relative to t is, at t, either true or else false.* (Markosian: 1995, p. 97)

- b. *Suppose that determinism is true, so that at no time is there ever a possibility for anything to happen other than what eventually does happen.* (Lockwood: 2005, p. 18)

In the first definition, open future is defined in terms of the failure of bivalence; the second definition kills off the debate before it can even set off.

But luckily for us, Benovsky (2013) has offered a useful distinction between three different types of determinism:

- (i) Metaphysical determinism;
- (ii) Causal determinism;
- (iii) Logical determinism

Metaphysical is the strongest kind of determinism. Benovsky's understanding of this kind of determinism strongly tied to eternalism: "if *eternalism* is true ... then the future is, metaphorically speaking, 'already there' (as well as the past and the present). It is thus determined simply because it exists." (Benovsky: 2013, p. 160). The ties are so strong, that one might understand (i) as simply the theory of eternalism. Causal determinism is the idea so succinctly expressed by Sider: "Here is the fact: *every idea has a cause*. This fact is known as determinism" (Sider: 2014, p. 115). Logical determinism revolves around the principle of bivalence. It is the idea that bivalence holds for every proposition, regardless of tense (see the standard argument for logical determinism on the beginning of the section "The Problem with Future Contingency"). An account that wants to make open future compatible with all determinism, should endeavour to satisfy all the possible interpretations of the term. In this chapter I will see if this is possible.

As we can see, the threat of the failure of bivalence is upon us again. Since we take bivalence to be something good, we wouldn't want to sacrifice it. Let's then consider again the problem of bivalence, which we need to get past somehow. The original doubt of open future was that bivalence fails because if it is true that there be a space battle in the future, it is true atemporally, and therefore the future cannot be open. However, if we want it to be open whether the space

battle occurs, then it cannot be either true or false if it occurs. The branching-world theorists can get past this problem by postulating histories or branches of different kind, but these branches have fallen off now. However, some philosophers have attempted to maintain the intuition of open future nevertheless.

One such argument has been offered by Barnes and Cameron (2009; 2011). For convenience sake, I will outline the problematic inference here one more:

- (3) If it's true now that there will be a space battle 2000 years from now, or true now that there won't be, then how the future is, is settled by how the present is.

What Barnes and Cameron promise to do is overcome three threats often connected to open future: problem of bivalence, indeterminacy, and anti-eternalism. The cornerstone of their theory is the question of *settledness*. Their argument runs as follows: it is true that there either will be a space battle or won't be one. What is unsettled is *which*; it is true that there either is a stack of hay on the road or there isn't. It is just unsettled *which*. They maintain that the principle of bivalence isn't violated, as long as there is some unsettledness in the antecedent.

Unsettledness opens the door to indeterminacy. There are two intuitions, or constraints, that Barnes and Cameron hold with their version of open future:

- (i) The real indeterminacy intuition
- (ii) The truth intuition

The first holds that a proposition, say, *there will be a sea battle tomorrow* is neither determinately true nor determinately false; the second holds that every proposition nevertheless has a truth-value, though the truth-value remains unknown until the future "unfolds".

Bivalence seems to be saved. How do they set to rescue determinism then? For this, they ask us to think of futures as a set. Call this set F, the set of all the possible futures or possible worlds. They further ask us to adopt supervaluationist semantics. Then, at every t, a presification will indicate *which* of the possible futures in F will be actual. Because of this, F is always diminishing in size and the indeterminacy is constantly diminishing. By the end of time, there will be only one possible world that gets it right, also by the end of time, there will be no indeterminacy in the furniture of the world left. Barnes and Cameron argue, that for open future, *some* indeterminacy is required, but they allow us to push the indeterminacy into ontology, and keep determinacy in natural laws.

Barnes' and Cameron's argument was motivated by three postulates. The postulates were that open future does not entail (i) failure of bivalence; (ii) indeterminism; (iii) anti-eternalism. However, they define unsettledness as „a type of *indeterminacy*”, and so, towards the end of the paper, they are forced to admit that some indeterminacy is required for open future, and this indeterminacy is crucial in upholding bivalence in their argument (2009, p. 304). Considering their definition of settledness, this „some” indeterminacy must be specifically metaphysical indeterminacy.

Barnes and Cameron do draw a distinction between two forms of determinism:

Strong determinism: The state of the world at a time t , together with the laws of nature, necessitate the state of the world at every time later than t .

Weak determinism: The state of the world up until time t , together with the laws of nature, necessitate the state of the world at every time later than t (2011, p. 302).

However, the distinction does little to alleviate the problem. Essentially, the strong form requires indeterminism in the present state of the world (i.e. straws of hay on the road), whilst the weak reading says that any indeterminacy in the present or the past will do. But both of these forms still require indeterminism, for otherwise there could be no *which* to settle and the whole story of presification, would become pointless. Yet, this indeterminism is metaphysical.

Of course, it might be argued that some indeterminacy is harmless. And this also seems to be the case that Barnes and Cameron make – as long as it is generally the case that ST is determined, we can be content. But then this is a claim that requires evidence. Again, we slip from $\forall x(Px|\sim Px)$ to $\exists x(Px|\sim Px)$. But this is clearly an empirical claim. And it should be measured somehow for objective evidence. A claim with no evidence can be dismissed with no evidence.

Secondly, let's go back to their objection to BST to which I did not reply before. Our understanding of BST and determinism at last is sophisticated enough for a reply. Remember that the core of their objection was that openness of future requires unsettledness, which is a kind of indeterminacy, and branching in BST does not allow for unsettledness. A rising concern about this objection seems to be the big role that indeterminacy plays in their account of open future. No doubt that indeterminacy is a concept closely related to open future, but Barnes and Cameron's response seems to makes these concepts a bit too strongly related. They don't seem to allow open future without indeterminacy. I have two things to say here. Firstly, BST can be

perfectly compatible with their own account of indeterminacy, depending on how we inhabit the universe. If we take the worm-counterpart theory, then it can still be unsettled which history branch *I* will branch off to. Say, I only got that many hairs on my head that it is unsettled if I am bald or not (their own example). It might be the case that in one of the future branches I will be bald and not in the other branch, so it is compatible with their own view that it is open whether I will be bald or not in the future.

Finally, for Barnes and Cameron, presification seems to be dynamic and moving in time. At least, Barnes and Cameron definitely do speak of the diminishing set of futures – so that by the end of time there will be nothing left unsettled. This however, requires A-theoretic time in their account of future openness. But then, it seems like the theory put forth by Barnes and Cameron falls out of interest for the current paper, as we are not interested in A-theoretic conceptions of time.

5.2. Open future

It seems that if we wish to keep determinism, and bivalence, but are unwilling to accept BST, then metaphysical openness might not be for us. But this doesn't necessarily mean that there is no sense to be made of the notion of open future. It is possible that we can still accommodate some (weaker) sense of open future into our framework that is not purely epistemic. Therefore, I will now turn my attention to whether open future in any weaker sense is possible.

To lay out a general framework of what we are about to argue, we must draw up some contextual background. Let's go back to causal determinism once again. Here is a way to give a lengthier explanation of its nature.

Think of the motion of light. From the perspective of any event *e*, light concentrates on it from its objective past, and then re-expands from it to its objective future. This is called the light-cone. Since, as far as we know, nothing can move faster than light, then light-cone is a common illustration for the nature of causality. Now consider a light cone of an event *e* (figure 4). the tip of the cone can be said to be the objective present of the event, whereas the light re-expanding from the event on our imaginary cone, is the absolute future of the event. Everything that can in any way bear an influence on *e*, lies within its past cone, and everything that the event *e* can influence in any way, lies in its future cone. So, if *e* causes anything *x*, then *x* is in *e*'s absolute future, and if something *y* has caused *e*, then *y* is in *e*'s absolute past. Therefore, *if*

causal determinism is true, then whatever happens at event e_1 just before e , must somehow cause e , and, vice versa, everything that happens at event e_1 just after e , must somehow be caused by e . It is not possible that anything happens at e_1 before its cause at e . This is the nature of causality. Reiterate this process to the whole of ST, and we get causal determinism.

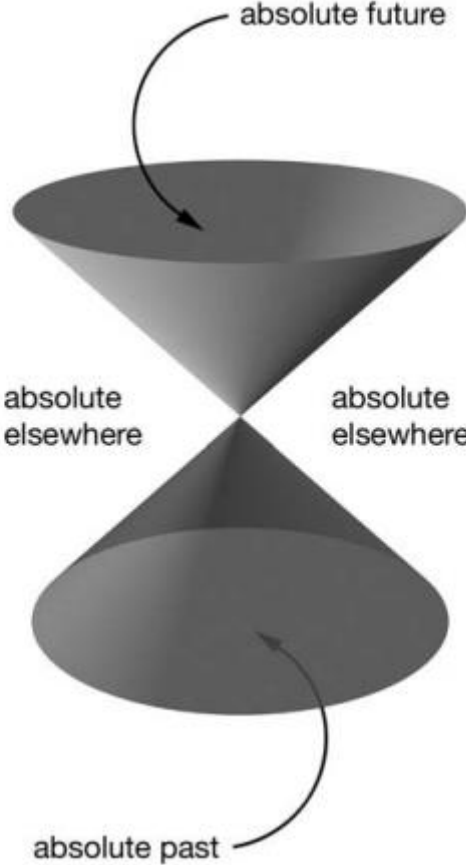


Figure 4. The light-cone. From (Lockwood, 2005)

The good thing is that bivalence is saved, as well as metaphysical determinacy – there is no asymmetry and everything in the past and future is fully settled. But does this leave any hope for open future, or does it crush the concept once and for all? Ismael (2012) has argued for a need to distinguish between two different perceptions of time: the temporally embedded view (TemP) and the temporally evolving point of view (TeV). The former means a representational point in time relativized to a particular moment. Apr/7/2019 is one of these points. All times preceding Apr/7/2019 are part of the past and all points succeeding it belong to the future. This is how time appears to most people.

The second option, TeV, we obtain by connecting TempPs. Ismael brings fourth an analogy of taking snapshots of different moments, stringing them together in temporal order and then run them through a film projector (Ismael: 2012, p. 152).

The two pictures are not competing, as Ismael argues, but just different perspectives on time. As agents, we are temporally embedded in time where nothing is set in stone for us. Why? Because we are active participators in time, with a volition to act. Additionally, we have beliefs, and our beliefs stand in a special relation to our volitions. Namely, our beliefs about our volitions are self-fulfilling, since, generally speaking, we do not err about what we want. Why is it infallible? Because one the one hand, once we make up our minds on something, our decision is at the same time a performative act, and on the other hand, I could *bilk* any time I wanted to. It's up to me.

How convincing is it? There are two ways of understanding this argument, a good way and a bad way. Following the bad interpretation, future is open because what is important for genuine openness, from the perspective of TempP, is *how things seem to us*, and this is essential in the final decision that you decide to make. Following this interpretation, it seems that Ismael's argument misses the point: when interpreting TempP in such a way, the framework in which the question of open future is important, shifts from genuine openness to merely epistemic openness. But this is not what we are after.

However, this might not be the final say in Ismael's account. Another way of interpreting her argument is that the emphasis should be put on the second half of the idea: the perspective of TempP is how things seem to us, and this is essential in the final *decision that I decide to make*.

To see the motivations for this interpretation, let's take a few steps back and ponder upon the nature of causation and us in the world. Firstly, we need to define ourselves in or our interaction with the world. Namely, we need to make two suppositions: (i) We are information-gathering and –utilising systems (IGUs), and (ii) we focus on the conscious decision-making (DM) processes in the mind (Ismael, 2016). That is to say that we actively interact with the world, collect information from the present and the past, and, using this information, bring about future events via DM.

So far, so good. But one might be curious of what exactly is this us, or this you? We can reduce much of ourselves and our cognition to simpler neurological (neurons, synapses, etc) and physiological (heartbeats etc) interactions, which in turn are reduced to chemical components

and physical interactions. Is it not true that no matter what I decide, my decision is still caused by something? For example, Sider (2014) has contested this line of thought, arguing that even if we don't perceive the causes for our own actions, it doesn't mean that they're not there. Maybe an argument that alludes to DM only pushes the explanation forward. We would like to ask more questions – who is this actor? Where do these decisions come from, that we could've made differently?

It is probably true (we do not yet know for sure) that consciousness fully emerges from neurological interactions in the brain. However, it is also true that from these neurological interactions, DM emerges. DM can be said to be a type of action instantiated by selecting a course of action amongst a set of possible actions (Grier, 2012). Further, DM often (though not always) occurs in highly complex, uncertain, and dynamic situations, and plays a crucial role in how the situation is going to play out or proceed.

It seems to me that the contention by Sider misses the point. Whilst, it is true that our decision in itself is caused by something and they do not just spring up from a totally free mind uncontaminated by the events of the past, it also seems a bit extreme to cancel out our decision on the whole. Miller (2013) has made a similar defence against the bleak no-possibilities predetermined future that is threatening us. Suppose that in the end you never had ice cream nor went to the movies. You are lying in your deathbed, thinking of all things you have done but having ice cream is not one of them. But this, Miller argues, does not imply that you had no say in this. It is exactly *you* in your whole life time that brought about this situation – it's your choices in life that bring about the conclusion. Further, if it actually is the case in the future that you never had ice cream, it is merely a contingent truth – if you had done different choices you might've had a wonderful ice cream

Let's think again of the event e on the tip of the light-cone. As said, (supposing causal determinism) what happens at e is wholly determined by whatever has happened in the past light-cone. Amongst these things, also lies the event of DM. If all the events that lie in the past light cone and in the present time point t determine what will happen at a future event e_1 , then the event of our DM is also one of the causes that determines the future. If we had made a different decision, a different event might have been brought about at $t+1$. Cancelling out DM is equivalent to saying that whatever we decide is completely irrelevant to what is going to happen. But this is not causal determinism anymore, this is fatalism!

It seems to me that we can make the argument stronger by introducing the notion of metacognition (MC). An important part of our DM is played by MC. MC refers to the executive functions of cognition, especially to functions pertaining to knowledge and regulation of one's cognitive processes (Morrison & Fletcher, 2002). Brown has argued that MC is the highest form of intelligence as it provides us with the tools of understanding ourselves as being self-regulatory organisms, agents of our own thinking (Brown, 1987). MC is closely related to the concept of awareness – by virtue of MC, we become aware of our feelings, thoughts, experiences and choice. MC is also related to controlling our thoughts, feelings, and actions. By being metacognitive individuals, we don't just blindly follow our instincts, and are able to ponder upon the situation we are in, our possible courses of action, consequences of them etc.

I think that Harry Frankfurt's (1971) concept of first- and second-order desires is made possible by being metacognitive, and essentially, choosing between these desires is the kind of DM that grants us open future. According to Frankfurt, our first-order desires are all our desires, other than desires we desire, whilst second-order desires are namely what we desire to desire. Our first- and second-order desires might be in conflict. For example, a drug addict may desire another shot and desire not to desire another shot. It's the second-order desires category, specifically, that to me seems to at least constitute a part of MC, since essentially desires about desires mean being aware of one's desires. But from this conflict of a desire we are aware of, and a (possibly conflicting) desire about our first-order desire, a possibility to do otherwise is born.

One objection might arise to what I am trying to draw out. It might be argued that MC is too specific to be useful for our purposes. For example, Frankfurt himself has claimed that second-order desires are characteristic of only humans (and even not all humans, as he excludes children). If open future is something that only some privileged individuals, or organisms, are granted, as it comes down to what our psychology is, then open future cannot be a metaphysical fact, and whatever we argue about DM, becomes irrelevant.

The reply to this is simply that we shouldn't be so convinced that MC is only restricted to human beings. Several tests with rhesus monkeys, apes, and dolphins for example, have suggested that these species have MC (Couchman, *et al.*, 2010). We simply don't yet know how common MC actually is. Nevertheless, if it turns out that MC is only restricted to some very privileged species, then I don't think it would harm my argument too much. Essentially, my argument still is that

DM is what grants us open future, and MC just sheds light to the mechanism of DM. But even species with no MC make decisions. These decisions might not be as innovative and complex, but nevertheless they choose one solution out of some set of possibilities, and this choice *could've been* different.

Without bringing in the notion of metacognition, Ismael arrives at a similar answer: she argues that by virtue of us being IGUS, the two notions of openness, epistemic and metaphysical merge into one, in one sense by deciding, we select one solution of a possible set, and (try to) apply it to the future that is epistemologically open to us, however, what will happen at $t+1$, is also (partly) dependent on the decision we choose to make, meaning that the future cannot be regarded any more fixed than our choices are, thus from being mere consumers of information, we become producers of information (Ismael: 2016, p. 150).

One potential concern that might arise with my proposition has to do with my presentation of determinism. My general argument is that the decisions we make are embedded in causal relations, since we have a MC awareness and control over our thoughts, feelings and decisions. And this awareness gives us the choice to do otherwise. Whether or not we decide to do otherwise, in turn, is (partly) responsible of what is going to be.

However, our decisions cannot violate causal relations. Therefore, if what I argue is true, then the *sentence if we had done otherwise, different laws would have obtained* must be true. This guides me to Lewisian account of causality/natural laws: causal laws must be dependent on the interactions between objects in the world, and not the other way around. Again, some might not agree with this, and demand for a stronger account of causality, such as Armstrongian⁴ laws.

I will not say much about this discussion here, as the question about the nature of causal relations is a full-blown debate in itself. However, seeing causal laws as some kind of iron bars restricting the movement of objects in the world, seems to render the question of open future meaningless before the question can even set off, and therefore is not interesting for our purposes. Moreover, when scientists speak of natural laws, they seem to have in mind not the iron bars type of laws, but the regularity theory.

Another point of concern that might arise is that the kind of openness I am arguing for, that the future is open simply because I could've done a different decision, might seem very weak,

⁴ See Armstrong (1983) for details.

indeed, too weak to be satisfactory in our quest for future openness. I agree that future then can be called open only in quite a weak sense. Nevertheless, it is true that our decisions play a role in the causal interactions that determine the future, and denying that role would be to say that the future is determined no matter what we decide to do about that. But this is not lack of open future anymore, this is fatalism. Therefore, I think it's fair to count this weak sense as a kind of future openness nevertheless, because it is our decisions and actions that partly determine what the future is going to be like.

5.2.1. Eternalism and Open Future

I have so far argued that the future is open, since we, as decision-makers, are intertwined with all other determinants into the causal interactions that determine the future. If we had made different decisions, the future would've been different. The openness of future at least partly emerges from our decisions.

Further, we have already seen different ways of how we can inhabit the branching ST. But how can we accommodate open future without introducing branches into our ontology? One might ask, where are these possible counterparts that have made different decisions from us? How do we make sense of them?

One possible answer was hinted at by Torre (2011; see 4.2.2). Specifically, in his reply to an objection by MacFarlane, he argued that it does not follow from the fact that a branch *will* not be a continuation of history, that this branch *is* not a genuine possibility of how things might be. I think he is right in this, but we need some other theory of ST to fit it into, other than the problematic TRL.

Luckily, we just might have one – the *ersatz* theory of BST. The *ersatz* BST theorist does not face the same problems that a TRL theorist would, since, for her, *ersatz* branches are not ontologically on a par with the one branch that represents the actual world. Unlike the TRL theorist, the ersatzist wouldn't argue that all the branches are in some sense equally real *and* that yet somehow only one of these branches is going to happen. For the ersatzist, there is only one real branch. All the other branches are just linguistic constructions or abstractions, that are invoked to represent possible futures, and, with it, our possible branched-off CPs. Thus, these *ersatz* branches represent the genuine possibilities of how things could've been. Therefore, ersatzist branching seems to be a good way of representing the weak sense of open future, that

I have argued for. All the different decisions, and actions that we could've made, are represented in the different *ersatz* branches, and we can think of them as genuine possibilities for things to have been different.

6. DISCUSSION AND CONCLUSION

The goal of this Master's thesis was to assess the possibility of accommodating open future in a four-dimensional block universe. For this purpose, two research questions (RQ1 and RQ2) were formulated. I will bring them forth once again for convenience's sake:

RQ1: Is open future compatible with eternalist universe?

RQ2: If yes, then in what sense is the future open in eternalist universe?

I defined the open future as the future not being fixed. I also pointed out that I call this the strong sense of open future, and if it should turn out that future is not open in that sense, but in some other sense, then this other sense will be called the weak sense of future openness.

As for RQ1, I demonstrated how the open future is compatible with a 4D universe in two different ways. Firstly, I made use of branching times framework and constructed a branching eternalist ST. I then proceeded to show three different ways for us to inhabit such a ST: we can be branching worms, inhabiting all the ST; worms that inhabit only one branch (with other branches being inhabited by our worm-counterparts); or we can just be us, with other branches inhabited by our temporal CPs, connected with us via genidentity relations. I then took up some counterarguments to the BST, and defended the theory against them.

I then sought for possibilities to accommodate the notion of open future with eternalism in a way that doesn't require invoking a branching theory of ST. I then argued that open future is still possible, if we adopt the correct perspective on our role in the amalgam of causal interactions. As decision makers, our future is open because we, or more exactly, our decisions are part of all the factors that determine how the state of affairs in the world is in the future.

Therefore, I conclude that RQ1 can be confirmed: we can indeed make the notion of open future compatible with eternalism. It is more obvious when invoking branching worlds, but we can also save open future without them.

As for RQ2, the conclusion depends on the choice of our metaphysics. If we are willing to accept BST, then we can accept the strong sense of open future. This is because different things are fixed in different branches. However, if we want the future to be open in a determinist universe without relying on BST, we must accept the open future in a weaker sense. We cannot have a metaphysically open future, since whichever is determined to be the case, has always been determined to be the case, and will always be the case. However, it is important to keep the correct perspective on this, and remember that we, as actors, or decision-makers, play a role in determining what will happen in the future. It is also true that we could've decided otherwise, and then the future would've been different.

In sum, I found confirmation for both of my research questions, and conclude that it is possible to accommodate the intuition of open future into the eternalist ST.

Open Future in Eternalist Universe

Avatud tulevik eternalistlikus universumis

Abstract

In this thesis, will take up the question of open future in eternalist universe. At first glance, eternalism seems to exclude the possibility of open future, since all temporal locations exist on a par, and what ever will be the case in a future time t , is already the case in t . However, we have very strong intuitions about our future being open.

Therefore, this Master's Thesis attempts to find an answer to two research questions: (i) is any notion of open future compatible with eternalist universe; and (ii) if yes, then what would that notion of open future be? I phrase a tentative definition of open future: the future is open if it is not fixed. I will call this tentative notion the strong sense of open future.

I will argue that we can have open future in a strong sense if we are willing to accept branching spacetime. If we are not willing to accept branching spacetime, then we can still construe notion of open future, albeit in a weak sense, that is compatible with eternalism. Then, I will argue, our future is open by virtue of decision-making.

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