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# Time-Travel, Causation, and the Direction of Time

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# Abstract

In this thesis I combine a definition of time-travel with issues in the philosophy of the direction of time and causation. I undertake some conceptual analysis of the notion of time-travel and I then ask what implications about time we must accept given the definition of time-travel that I have proposed. I then offer a new way of representing the taxonomy of views on time, and I argue that A-theoretic views (which I define as those that are realist about the moving present) are incoherent. In doing so, I pay particular attention to McTaggart's paradox and some analogues of it. Furthermore, I show that A-theoretic views are incompatible with my definition of time-travel, and that the problematic feature is the A-theorists' commitments surrounding the ordering of time, and the moving present. I show that it is the A- versus B-theoretic dispute, and not the Eternalist versus Presentist dispute, that is most relevant to time-travel debates. This leads me to a discussion on the philosophy of the direction of time. I argue that there is no way to objectively pick out one of the two directions in time as the privileged direction of time, and that *the* direction of time is given by convention only. I reject the thermodynamic/entropic account of the direction of time, and endorse a causal account on which the direction of time and the direction of causation cannot come apart. Additionally, I appeal to psychological features of agents in time (such as memory accumulation) to account for the assignment of a direction to time, and for the experience of a passage of time. I then show that direction of time plays a crucial role in time-travel stories, and that on my combination of a causal theory with a psychological or memory accumulation theory we can give a tidy account of what is happening with time in time-travel stories.



# Dedication



This thesis is dedicated to Socrates, Bill, and Ted,  
who began my love of Philosophy and Time.

---

<sup>1</sup> (Herek 1989)



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*Ehara taku toa takitahi, engari he toa takitini*





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# Introduction

At the beginning of this project it seemed obvious to me that the direction of time and the direction of causation played a crucial role in time-travel stories. However, when I began to explore the literature I could not find any work that made this link explicit, nor discussed in any depth the importance of the direction of time and of causation in time travel stories. I also had the idea that the reason Presentism was said to be incompatible with time travel was not, as often thought, primarily because it denied the existence of moments other than the present. But, more importantly, because of its commitment to a single, objective, moving present and consequently how it orders moments of time. Essentially, I felt that the debates surrounding the passage and direction of time were more relevant than the debates surrounding Presentism and Eternalism when it came to the philosophy of time-travel. Thus began my project.

Employing time-travel in thought experiments while doing philosophy of time is a valuable tool. Time-travel thought experiments drive us to look differently at questions in philosophy of time. They highlight questions that are not prominent when confined to philosophical analysis without time-travel. They also provide answers that we would not have considered otherwise. My examination of the combination of time-travel with the direction of time and of causation is an original starting look at questions and possible answers in this area of the philosophy of time-travel, which, as the reader will see, also ties in with questions in philosophy of time in general.

I begin the thesis by undertaking some conceptual analysis of the notion of time-travel. Very little, beyond passing comments here and there, has ever been said about how we should define time-travel. I begin by searching for a definition in terms of necessary and sufficient conditions. I consider a number of types of time-travel stories that we seem to

include in our pre-theoretic notion of time-travel, such as Lewisian time-travel (1976), time-travel via traversable wormholes, time-travel in Bill and Ted's Excellent Adventure (1989), and so on. I also consider cases that are not usually captured by our intuitive notion of time-travel, but are perhaps time-travel-like – such as rewinding and fast-forwarding time, cryogenic freezing, and remote viewing. I look for the features that are missing from these stories. As can happen when undergoing conceptual analysis, a consistent application of principles rules out some instances that we may have thought were instances of time-travel. For example, cases of time-dilation must be ruled out. Although at the outset, time-dilation looks like time-travel, time-dilation can and does happen at small degrees everywhere in (actual) space-time. Hence allowing time-dilation into our definition commits us to some absurd consequences. Unless we want to accept that time-travel admits of degrees, that many of us are time-travellers, and that whether we are or not is relative to the motion of others, then we should rule out time-dilation as time-travel. This is because we cannot draw a theoretically motivated line in the sand to demarcate time-travel time-dilation cases from those that are time-dilation but not also time-travel. This is just one example of the sorts of things I consider in this first chapter.

I propose what I call the 'isolation, encapsulation and exemption' (IEE) condition of time travel and use this to present my paradigm case of time-travel. I require that time-travellers really, genuinely travel somewhere in time, and that they do so via some method of being isolated, encapsulated and exempt from time and causation in (Lewisian) external time. I hold that we should take (Lewisian) personal time to be, not just a mere rhetorical device or subjective causal experience of the time-traveller, but an objective yet localised region of space-time, in which time and causation are isolated, encapsulated, and exempt from the time and causation outside the localised region. As I will show in Chapter One, this IEE requirement nicely captures what is going on in time-travel stories, and also explains why we should rule out certain time-travel-like stories. The stories that meet the criteria of my definition of my paradigm time-travel case, I call 'strong' time-travel stories and those that do not but are time-travel-like; I call 'weak' time-travel stories. Although my definition may not coincide with everyone's concept of time-travel, I believe it at least characterizes one distinctive and important

kind of time-travel concept – and one which is both clear enough and popular enough to be worth devoting this thesis to.

Chapter Two is divided into two parts. Part I focuses on the classification system of philosophical views in philosophy of time. I argue that there are (at least) two main dichotomies at play here. The first is the debate between realism and anti-realism about the existence of moments other than the present. These positions are called ‘Eternalism’ and ‘Presentism’, respectively. The second dichotomy is between realism and anti-realism about the passage of a single, objective, moving present moment. I call views which are realist about passage, ‘A-theories’. Views which are not, I call ‘B-theories’. In this thesis my main focus is on this second dichotomy. I believe that a person’s positions on the passage of a single, objective, moving present moment and the direction of time play the most important role in their time-travel stories. I defend my view that philosophy of time is often over-simplified by assuming that there is only one dichotomy, and that there is only one way to combine the views from each dichotomy. This results in complicating the discussions in philosophy of time. For example, the B-theory is often called Eternalism, but this makes an assumption about how the two dichotomies should be paired, since there are views (moving spotlight, branching tree, and growing block) which are Eternalist and also A-theoretic, i.e., are both realist about moments other than the present, and realist about a single, objective, moving present. I then present a novel and helpful way of representing the classification system that I have made explicit.

In Part II of Chapter Two I present problems for the A-theory. This is primarily done by rejecting and defending the work of others. I focus largely on what is known as McTaggart’s paradox, which highlights that the notion of a single, objective, moving present is logically incoherent. This is because A-theoretic properties – pastness, presentness, and futurity – can only be made sense of *at times*, but times are what the properties themselves are employed to explain. The explanation is circular, and any attempt to avoid it results in an infinite regress of explanation. I will show that many objections given to A-theoretic views are in fact analogues of the problem highlighted by McTaggart’s paradox. I also show that the attempts to address these objections



merely employ the same problem at another level, and hence they too are analogues of the infinite regress from McTaggart's Paradox. I argue that all A-theoretic positions fall prey to this problem; including Presentism, which is often said to avoid it. I focus on problems that face the A-theory in order to prepare the way for Chapter Three where Chapters One and Two are combined.

Chapter Three combines the time-travel definition from Chapter One with the A-theory and its problems from Chapter Two. This combination will highlight that time-travel, as defined in Chapter One, is incompatible with an A-theory. It also highlights that the logical problems, which face the A-theory, become exacerbated when combined with time-travel. I consider defences of Presentist time-travel and show why they do not succeed, as well as highlighting some novel problems for A-theoretic time-travel in general. There are two main ways of conceptualising A-theoretic time-travel. The first holds that the objective moving present continues on in time while the time-traveller goes back in time, or, the objective moving present does not continue on in time, but rather, goes with the time-traveller. I argue that such a conception leads to absurdities. The first conception becomes clearer when it is contrasted with the second. This second conception is more popular with A-theoretic – especially Presentist – defenders of time-travel. It holds that when a time-traveller goes to the past, it *becomes the case* that the time-traveller *did* exist at that past moment when it was the present, and that the cause (or one of the causes) of this fact is the events that happen at the present (such as a departure event). I reject defences of this type of time-travel and argue that this conception cannot satisfy the requirements of our time-travel definition from Chapter One. I hold that, at most, the A-theorist can tell a time-travel-like story. Where possible, I emphasise my conviction that it is a theory's position on the single, objective, moving present, that causes problems for its ability to accommodate time-travel, rather than its position on the existence of moments other than the present. By this I mean that the A-versus B-theory debate is more relevant to time-travel stories than the Presentist versus Eternalist debate. I also begin to introduce my conviction that the features of the A- and B-theories' commitments about *the direction of time* play an important role in their compatibility (or lack thereof) with time-travel. I explain that this is because time-travel

requires certain temporal and causal orderings that an A-theoretic position on the direction and ordering of time cannot provide.

Chapter Four focuses on the direction of time. I begin by making a distinction between the structure (i.e., non-directed order), direction, and passage of time, and by highlighting the disanalogies between time and space. I will then go on to examine what we might understand the notion of a direction of time to be. I reject the option of understanding the direction of time as being the direction of a single, objective moving present. This is because Chapter Two showed the objective, moving present to be a logical impossibility. I then consider the option of understanding the direction of time as given by asymmetries in time. I argue that we should reject the possibility that any asymmetry in time can give a privileged direction in time. I instead endorse the position that asymmetries can only give us *directions* (plural) in time, and ways to orient ourselves in time. Given this, I argue that we must accept that direction is given by convention, rather by some objective feature of time. For the remainder of the chapter, I put aside the constraint that a privileged direction be assigned by convention. I return to this in Chapter Five. I go on to consider two instances of asymmetries in time: entropy and causation. I present an overview of the entropic or thermodynamic account of the direction of time, which reduces the direction of time to the direction of entropy increase. I consider some objections to this view, such as reversibility objections, and what is called ‘the problem of the direction of time’. The objections show that the entropic account is at least not *logically* necessary, and this leaves room for the possibility of a causal theory. I then defend (a general notion of) a causal theory of the direction of time against some logical objections. I do not specify any real details of the causal theory; I merely want to defend it as a coherent position. I show why I think the causal account is more promising than the entropic account. I do this so that in Chapter Five I can combine the causal theory with the notion of direction as a convention, and with the notion of time-travel established in Chapter One.

I believe that using a causal theory – where the direction of time and the direction of causation cannot come apart – gives us some interesting and helpful results in time-travel stories. This is the goal of Chapter Five. I begin the chapter by showing that on a

causal theory, one can have backwards time-travel without backwards causation. This is a novel and important result as it is generally held that backwards time-travel involves backwards causation. The causal theory allows us to avoid backwards causation, and to easily ensure a number of features that are demanded by the definition in Chapter One. Using the causal theory also generates some tidy answers about what is going on with time in time-travel stories. In this chapter I also consider a reversibility objection applied to the causal theory. The reversibility type of objection is an objection normally used against the thermodynamic or entropic account by providing a counterexample which shows that the direction of entropy increase and the direction of time can separate. The (counter) example that I use in the causal version of such an objection is analogous to the time travel story. But in the case of the causal theory, the reversibility objection does not succeed in showing that time and causation separate.

In the next part of Chapter Five I consider issues that arise from conclusions reached in the previous chapter. The B-theorist must account for why we seem to experience a passage of time if they deny that there is such a thing, independent of our experience. I will answer by appealing to the role of memory accumulation. I also appeal to memory to account for a privileged direction to time and causation; the direction in which we accumulate memories is the direction which we use convention to label as *the* direction of time. The need for such an account follows from Chapter Four where I explain that while the asymmetries in time and causation can give us directions (plural), as well as orientability in time, one thing lacking from the reduction of the temporal to the causal is a way to assign one of the directions in time to be *the* direction of time. I explain local time, and also defend the logical possibility of backwards-brains scenarios. Local time is when the direction of time and the structure of events in space-time are not directed/ordered the same all over space-time, but rather, can be oppositely directed and structured in localised regions. By contrast, in backwards-brains scenarios the backwards-brained people and the non-backwards-brained people will assign direction oppositely in the same region of space time. This is not due to any difference of space-time itself (as in the local time cases) but rather, due to the oppositely directed *brains* (or minds) of the backward-brained people. Note that allowing for backward-brains scenarios is not a consequence of the definition of time-travel from Chapter One, but

rather a consequence of denying that asymmetries in time can give us a way to privilege one of the two directions on time. This is, in turn, a consequence of adopting a B-theoretic approach to the direction of time, i.e., denying that the direction of time is given by the direction of the objective moving present moment.

*“Time is an illusion. Lunch time doubly so”*

*– Douglas Adams*

# 1 Defining Time-Travel

We seem to think we have a concept of ‘time-travel’,<sup>2</sup> we seem to understand what we mean by it, what we do not mean by it, and what kind of cases should not be understood as accounts of time-travel. However, what we mean by ‘time-travel’ is not always as clear-cut as we might think, as this chapter will highlight. The methodology this chapter takes will be as follows. I will begin with (1) a vague folk notion of time-travel and (2) Lewis’ watershed requirement of a discrepancy between personal and external time; a requirement of a discrepancy between the duration of the journey and the duration between the departure and arrival times. I will discuss a number of problems that can be raised against this requirement as a necessary and sufficient requirement for time-travel. I will also consider various cases that may be thought to be instances of time-travel. It should be noted that the when we look closely we see that the folk notion of time-travel is not always consistent, or at least, not all notions of time-travel are logically coherent (for example, auto-infanticide cases). I will present various objections to certain time-travel cases, showing why they are logically or metaphysically problematic. I do not want a conception which captures logically problematic or impossible cases; I want to exclude these from my definition and only work with logically possible cases of time-travel. These considerations will motivate my endorsement of a paradigm (and perhaps revisionary) conception of time-travel which I hold does not run into the problems raised for some of the cases considered. I will present my Isolation, Encapsulation and Exemption (IEE) requirement, which I believe captures what is going on in my paradigm case and pinpoints where the problems lie

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<sup>2</sup> Note that the terms ‘time-travel’ (two words) and ‘timetravel’ (single word) will always be written as ‘time-travel’ (hyphenated), including within quoted works. This is to avoid ambiguity when using a noun-phrase as a verb, like the term time-travel does. For example, compare “I time travel by the sun, others time it by the clock” with “I time travel by the sun, others do so past the moon”.

for the cases that I showed ran into logical, metaphysical or conceptual problems. I will then use this IEE requirement to capture my paradigm time-travel case, and I will use this type of time-travel story for the remainder of the thesis. Note that I do not want to say that time-travel stories that do not meet my IEE requirement are not truly time-travel. Rather I will say that they are “weak” time-travel stories because they face various objections that I have raised, such as not being logically consistent or coherent. I will make a distinction between “strong” time-travel cases – those which count as cases of paradigm time-travel according to my conception – and “weak” time-travel – those cases which may be time-travel-like or intuitively seem to be time-travel, but do not meet the requirements of my paradigm conception of time-travel.

Note that this chapter will primarily be an original venture as there has been no substantial discussion on which sorts of cases should be counted as time-travel and which are merely time-travel-like, nor much work on defining time-travel (finding necessary and sufficient conditions for some characterisation of time travel). Therefore there is little published work from other philosophers to discuss. I do not pretend to have finished the work that needs to be done on defining time-travel, or coming up with a conception of a paradigm case. I have merely made a start to some of the questions that should be asked, and have developed a paradigm case of time-travel that we may employ in the following chapters.

### **1.1. What is Time-Travel?**

Let us begin by considering a brief time-travel scenario. I will use Lewis’ (1976) time-travel story as it is the most well known in contemporary philosophy.

*“Consider Tim. He detests his grandfather, whose success in the munitions trade built the family fortune that paid for Tim’s time machine. Tim would like so much as to kill Grandfather, but alas he is too late. Grandfather died in his bed in 1957, while Tim was a young boy. But when Tim has built his time machine and travelled to 1920, suddenly he realizes that he is not too late after all...”* (Lewis 1976, 149).

In the above case Tim has travelled back in time 56 years (assuming he left from 1976 when Lewis was telling the story). We might also imagine that he spends an hour

travelling to the 1920s. So what is Time-travel? Well, *spatial* travel is “in virtue of occupying different places at different times” (Le Poidevin 2003, 174), so perhaps we time-travel in virtue of occupying different times at different times. Yet as Le Poidevin points out, this claim “is either trivial or nonsensical” (2003, 174). It is trivial if all this means is that “we occupy 8:15am at 8:15am and 4:30pm at 4:30pm”. This is what we normally do in virtue of merely existing in space-time, and we do not want our normal existence to count as time-travel. Alternatively we could interpret Le Poidevin’s claim as saying that the time-traveller “can occupy 4:30pm at 8:15am” yet this, at least on the face of it, is nonsensical. Perhaps the word ‘travel’ is misleading when it used to refer to what happens when we ‘time-travel’, because our notion of what it means to travel is so bound up with movement through *space* as well as time. Hunter wonders,

“...might there also be vagueness in the word ‘travel’? Our use of the word ‘travel’ implies two places: an origin and a destination.<sup>3</sup> ‘I’m going to Morocco’ means ‘I’m departing from my origination point here and I plan to arrive eventually in Morocco.’ But when we are speaking of time-travel, where exactly does a time-traveler go? The time of origin is plain enough: the time of the time-traveler and the time-traveler’s surrounding world coincide at the beginning of the journey. But ‘where’ does the time-traveler arrive? Are we equivocating in our use of the word ‘travel’ by simply substituting a *when* for a *where*? In truth, how do we conceive of a ‘when’—as a place, a locale, or a region?” (Hunter 2004, §2).

Here Hunter can also be seen to be questioning whether the notion of time-travel might require us to spatialise time, or in other words, to adopt a view of time as a dimension. This view is sometimes called four-dimensionalism or the B-theory.<sup>4</sup> Does the notion of travel imply two places – a departure and an arrival place – and can those places be times? In Chapter Three, I will discuss whether my paradigm case of time-travel (that I will develop shortly) requires us to adopt a spatialised view on the nature of time, and argue that it does. But let us now focus on the question of what time-travel

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<sup>3</sup> Note that in §1.11, Chapter Three, and Chapter Five I will endorse the idea that there is far more than just the departure and arrival times, and that we also need there to be intervening times (between departure and arrival) in a time-travel story.

<sup>4</sup> I will explain the definitions and taxonomy of these views in Chapter Two.



is. Lewis makes a similar time-travel requirement along the same lines as that of Le Poidevin. He states that “time-travel involves a discrepancy between time and time”, and he claims that “if he is a time-traveller, the separation in time between departure and arrival does not equal the duration of his journey” (Lewis 1976, 145).<sup>5</sup> For example, Tim the time-traveller travelled 56 years into the past, but it only took him ten minutes to travel there. Another philosopher, Grey, states that it is a “*requirement* for the possibility of time-travel is that two successive events may be separated by unequal amounts of time” (1999, 58. Emphasis added), and I think it is correct to hold that without this discrepancy the travel does not count as ‘time-travel’ as we generally think of it.

By way of illustration, let us consider a kind of time-travel story without that discrepancy. Suppose I hope to travel five minutes into the future, but that it will take me five minutes to get there (so there is no discrepancy). In fact, my method of travel need not involve anything but every day activities: having a cup of tea or reading the news. And after five minutes have passed it is true that I have travelled five minutes into the future. But this is just the regular every day time-travel that is temporal existence. It is not the stuff of science fiction, and it not what we want our concept ‘time-travel’ to pick out. So let us begin by holding that this discrepancy is somehow required in a definition of time-travel.

### ***1.2. The Two Times Problem***

Some philosophers have thought this notion of a “discrepancy between time and time” to be problematic, for “how can it be that the same two events, [the time-traveller’s] departure and his arrival be separated by two unequal amounts of time?” (Lewis 1976). As Le Poidevin said, it is ‘nonsensical’ to claim that “to travel in time is to occupy different times at different times” (2003, 174). This problem is sometimes called ‘the two times paradox’ (Dowe 2000). Grey claims that due to this discrepancy requirement, time-travel “seems to involve either assigning the same moment in 1920 two distinct

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<sup>5</sup> This way of phrasing it is also used by Keller and Nelson (2001, 334).

places in the time series, or assigning it the contradictory properties of both preceding and succeeding a moment in 2000” (Grey 1999, 58) or both preceding and succeeding the departure event in 1957. Bigelow’s (2001, 59) paper highlights this problem by way of the following dialogue:

“Once upon a time someone travelled forward to the distant future. (Puzzled looks from the audience) ... I mean, he left the present and then a few seconds later he was doing things many years later.”

“Do you mean that he did things many years later, but it seemed to him to be just a few seconds later? – like *Sleeping Beauty* or *Rip Van Winkle*?”

“No, a few seconds later it really was many years later...”

It seems that we require this discrepancy between time and time in order to make sense of time-travel stories and in order to demarcate them from non time-travel stories. The problem is that this discrepancy requirement appears nonsensical, at least at first.

### 1.3. Two Dimensional Time Solution

One solution to making sense of this requirement might be to employ an account of two-dimensional time. As Lewis says,

“It is tempting to reply that there must be two independent time dimensions; that for time-travel to be possible, time must not be a line but a plane. Then a pair of events may have two unequal separations if they are separated more in one of the time dimensions than in the other. The lives of common people occupy straight lines across the plane of time, sloping at a rate exactly one hour of  $time_1$  per one hour of  $time_2$ . The life of the time-traveller occupies a bent path of varying slope.” (1976, 135)

Meiland (1974) gives just such an account of two dimensional time and time-travel. On Meiland’s account we can imagine that the life of a non-time-traveller to be represented by a positive slope from  $t_1$  to  $t_7$ , on a diagram with *both* the x- and the y-axes representing one of each of the *two* dimensions of time. See figure 1 for Meiland’s own diagram. This diagram shows two time axes,  $P$  and  $Pt$ . Each of the commonsense times,  $t_1$ ,  $t_2$ , etc, are really a product of two time-series positions, one on the  $P$ -axis and one in the  $Pt$ -axis. Meiland’s account has two temporal dimensions. This allows us to make sense of the notion of a discrepancy between time and time. Lewis explains that “a pair

of events [such as departure and arrival], may have two unequal separations if they are separated more in one of the time dimensions than the other” (1976, 135). For example, in figure 1, position A ( $Pt_1, P_5$ ) is separated from position B ( $Pt_1, P_4$ ) by one unit in the P dimension, but no units in the  $Pt$  dimension, as both A and B are found at  $Pt_1$ .

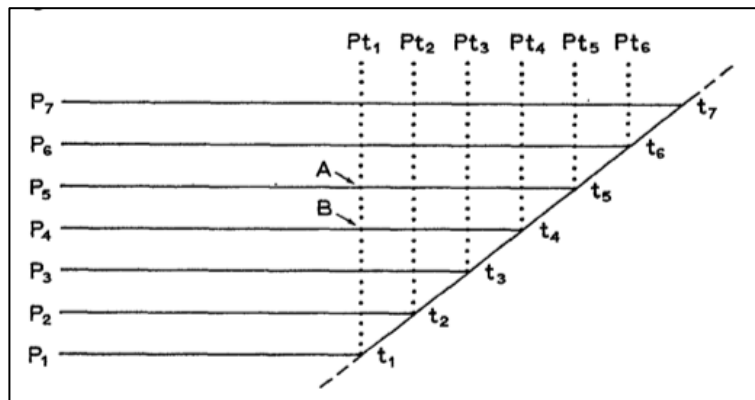


Figure 1: Meiland's Diagram of his Two Dimensional Model (Meiland 1974, 163)

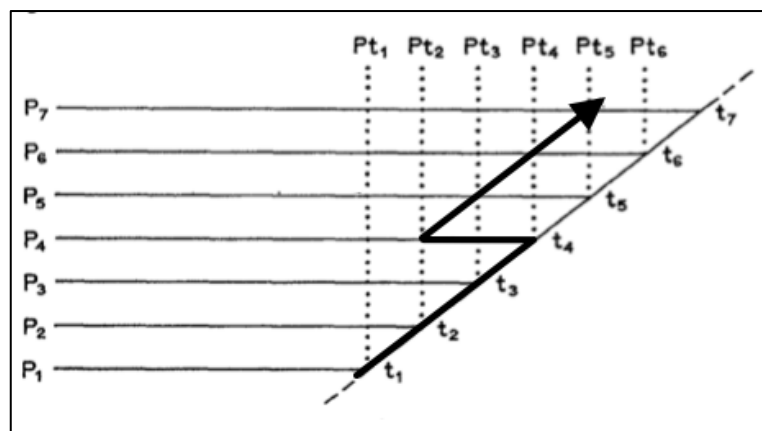


Figure 2: Meiland's Model with an added time-traveller.

The problem with Meiland's account is that when the time-traveller (see figure 2) leaves his regular world line<sup>6</sup> and travels back in time, he does not travel back down the line he came along ( $t_1$  to  $t_4$ ), but rather, into the past of the moment which he left from

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<sup>6</sup> A world line is a line that represents and tracks an individual's movement through four dimensional space-time. A two-dimensional analogue would be a line on a map that represents a journey from one place to another.

which is not the same thing as his own past (but is parallel to it), and, which is represented as being a vertical line – from  $t_4$  to  $(Pt_2, P_4)$  – which is to the left of the moment which he left from ( $t_4$ ). The time-traveller's world line is therefore represented as a positive sloping line, and then a horizontal line moving to the left, and then again a positive sloping line – as a zigzag of sorts. But note that this is an unusual account of time because Meiland thinks that it allows for the past to change,<sup>7</sup> he holds that on his model we can “give up the assumption that the past is fixed and eternally changeless” (1974, 158). It is also unusual because each moment will have a different past associated with it, says Meiland (1974, 160). Presumably, both  $(Pt_2, P_4)$  and  $(Pt_4, P_6)$  will be in the past of  $t_4$ . When I say that “each moment will have a different past associated with it”, I do not mean that Wednesday the 23<sup>rd</sup> has a different past than Monday 21<sup>st</sup> because Wednesday has Tuesday the 22<sup>nd</sup> in its past and Monday does not. This is the normal sense in which different moments, or periods in time, have different pasts. What is meant, on Meiland's model, is that Wednesday's past includes a different Sunday the 20<sup>th</sup> than the Sunday the 20<sup>th</sup> in the past of Monday! However, if the time-traveller is not going back in time to where he came from, and hence not going back in time in both dimensions of time, but rather is moving back in time in only one of the dimensions of time, then it is not at all clear that this should be classified as time-travel in any normal sense of the word. When we think of a backward time-traveller, we want him to be going backward to times in his own past – not necessarily times that he himself experienced, such as his 5<sup>th</sup> birthday, but times that are parts of the history of his own world. No doubt Meiland's time-traveller is travelling in time, but he is only travelling in *one* of the dimensions of time. It is not clear why, on Meiland's account, the time-traveller cannot travel back to the past *he* experienced, nor is it clear what it would be like to arrive at a time that was in the past in only one of the two temporal dimensions (nor what events would be happening at that moment). But it is clear that this is not our usual conception of time-travel. In time-travel towards the past there should be the possibility of the time-traveller being located twice over in a single space-

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<sup>7</sup> It is not clear to me that this truly classes as changing the past. I will not discuss this here however, and instead discuss the notion of changing the past in §1.13.

time region but at different personal stages. This can never happen on the Meiland model.

Why might we want the time-traveller to be able to travel in both dimensions of time? Consider this:

*“...this account [one like Meiland’s] seems not to give us time-travel as we know it from the stories, When the time-traveller revisits the days of his childhood, will his playmates be there to meet him? No; He has not reached the part of the plane where they are. He is no longer separated from them along one of the two dimensions of time, but he is still separated from them along the other” (Lewis 1976, 145).*

If we want my paradigm conception of time-travel to capture cases of time-travel as described in stories such as *Back to the Future* (1985), *Bill and Ted* (1989), *12 Monkeys* (1995), and *The Time Traveller’s Wife* (2004)<sup>8</sup> then we might want to reject Meiland’s two dimensional time as a way to account for the requirement of a discrepancy between time and time, since it gives the wrong answer to certain cases. Perhaps another account of two-dimensional time would fare better?

Schlesinger (1994) Craig (1998) and Bigelow (1991) are three philosophers who have given an account of time which might be interpreted as an account of two dimensional time.<sup>9</sup> They are accounts that translate talk of past and future into talk modality and possible worlds. These accounts are usually intended to avoid some of the problems faced by an A-theorist (a realist about passage) by appealing to possible worlds. Bigelow and Craig have also developed similar accounts of possible-worlds time, but I will discuss Schlesinger’s account here, as use of his diagram can be helpful. Schlesinger’s account of time can be represented by a diagram (see accompanying diagram (Schlesinger 1994, 265, fig1)) in which one axis of time – the B-series – can be represented as we normally think of it, as a series of events. While the other axis – the

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<sup>8</sup> Note that some of these will be excluded nevertheless by the end of the chapter due to the ‘IEE’ requirement.

<sup>9</sup> Gratitude to Paul Daniels, Monash University, for pointing out the Schlesinger model of two dimensional time as one that might be interpreted as an account which might be said to withstand this objection of Lewis’.

$\Sigma$ -series – is almost to be thought of as a stack of possible worlds, each containing the same series of events in the same order, or as Schlesinger puts it “the ordering relation along the vertical axis is the increasing number of worlds that have achieved actuality” (1994, 266).

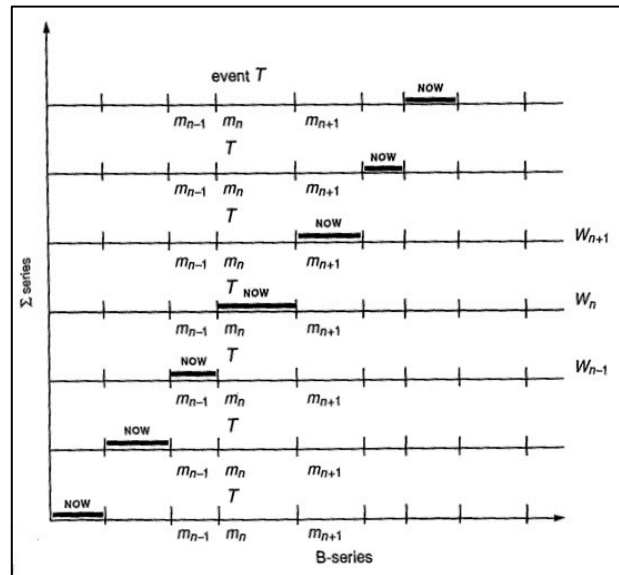


Figure 3: Schlesinger's Two Dimensional Model (Schlesinger 1994, 265, fig1)

On this account, presentness is not a property that moves along a one dimensional time line. Rather, presentness is had by a single moment in each of the possible worlds. The world that is actual, at time  $t$ , is the world with presentness at time  $t$ . On this model, the passage of time is to be understood as the successive actualisation and then un-actualisation of successive moments across possible worlds. A justification behind such a model of time is that if event  $E$  is present in our world, then it is possible for event  $E$  to be future. In which case it follows that there is a possible world in which event  $E$  is future, and likewise a possible world in which event  $E$  is past.<sup>10</sup> On this model of time, we could account for people's existence through time by employment of a possible world counterpart, or person-stage, or some other mechanism. On this model

<sup>10</sup> Bigelow (1991) gives a justification along these lines.

a time-traveller could travel from the NOW<sup>11</sup> to an earlier or later moment in another possible world that is actual (i.e., is NOW).

There are a number of ways to interpret the Schlesinger story, and others like it. We could interpret it as a case in which both time-travel and the normal passage of time requires a type of world-jumping. In that case, we could appeal to the existence of our possible world counterparts at the counterpart *times* of our *actual* world's past and future, and therefore we could say that we exist cross-temporally. For example, by appealing to the existence of our possible world counterparts at moments that are past and future in the actual world, but present in the possible worlds. However, note that I will consider why this type of understanding of time leads to a logical absurdity in §2.2. Another way of understanding the world-jumping version of Schlesinger's story would be to have the same person existing across possible worlds; existing at a single successive moment in each possible world. This would be a more literal understanding of world-jumping than in the case just mentioned. However, possible worlds are typically understood as being spatio-temporally isolated from one another. On a Lewisian view of possible worlds, this means that it is not possible for one and the same person to exist in successive moments across possible worlds. On an alternative, Kripkean view of possible worlds, it is possible for one and the same person to exist in successive moments across possible worlds – but also at the very same moment, and earlier and later moments also. But this Kripkean view is by no means a notion of 'world-jumping', which would presumably violate at least the condition of causal isolation of worlds, which I will explain and endorse in §1.11.

Alternatively we could slightly modify the story above and hence avoid the problematic world-jumping scenario by thinking of Schlesinger's set of 'worlds' as all part of a single mega-world. In which case the Schlesinger story is rather like Meiland's two

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<sup>11</sup> Throughout this thesis I will refer to the objective moving now as 'NOW', capitalised to demarcate it from the notion of an indexical now, or from 'now' used as per everyday colloquial discussion. This is a convention used elsewhere, such as in Braddon-Mitchell (2004). Alternatively, Forrest (2005) uses 'now<sub>i</sub>' to refer to the *indexical* now, and 'now<sub>b</sub>' to refer to the now at the *border* of reality or the edge of being.

dimensional account: rather than one person existing across possible worlds, one person exists on a plane across the two dimensions of time. It should be noted that Schlesinger does not say that his account of time is a two dimensional account of time. Rather, he says it is an account of time with *two different time series*. The horizontal axis represents the B-series, the normal ordering of events in time, while the  $\Sigma$ -series replaces the A-series in order to account for the passage of time. I will return to questions about possible worlds and their relation with the passage of time in §2.2. The question we should ask here is whether *a set of worlds* which, taken together, have two different time series is the same thing as *one world* having two different time dimensions. I think not. This is because one-dimensional time can also have two different time series, as both the A- and the B-series might be said to.<sup>12</sup> The A-theorist thinks that both an A-series and a B-series can apply to the one dimension of time. Additionally, it might be said that *personal and external time* are two different time series – they are certainly two different ways of ordering time. I will return to personal and external time in the following section. So, it may be the case that Schlesinger’s account of two time series, a B- and a  $\Sigma$ -series does not give us reason to infer that his account is really an account of two-dimensional time, but nevertheless, let us for the moment imagine that Schlesinger’s account of time *could* be understood as a kind of two dimensional time and consider why it won’t solve the problem with our discrepancy requirement.

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<sup>12</sup> There are two things to note here. **Firstly**, there are ways in which the A- and the B-series are not analogous to a two dimensional account. Primarily, the A- and the B-series are not two independent series, but rather two different ways of ordering events into the same series. Chapter Two will contain a thorough investigation of the A- and the B-series. **Secondly**, I mean to refer to the A- and the B-series’ way of ordering moments or times, and not the other entailments of the A- and B-theories. As I will argue in the following chapter, there can be no view of time which is both an A- and a B-theory view because the two are mutually exclusive given that one accepts and the other rejects the notion of an objective moving present. I will explain in §2.1.3 that the A-series implies or includes a B-series, if we take the B-series to be a basic ordering (but does not imply a *B-theory*, as this is also the rejection of the objective moving now).



The **first problem** with Schlesinger's account of time applied to time-travel is that it reduces time-travel to a type of world-jumping. The time-traveller can return to his past by jumping into a possible world in which the moment in the past that he wants to return to is present (or actual). But while this may be one way to account for time-travel, it is not strictly speaking time-travel if it is instead possible-world-jumping. We want the time-traveller to be travelling back to the past in his own actual world, not the past in some possible world in which the moment that he is travelling to is present.

However, **one reply to my objection** would be to point out that if our normal temporal existence and passage through time consists of world-jumping, as it does on Schlesinger's model,<sup>13</sup> then of course time-travelling back to a moment in the past which the time-traveller existed through before, will involve world-jumping, because that is merely what movement in time involves. While I think that an objection of this sort would be sound, I hold that our normal existence does not involve world-jumping. As the focus of this chapter is on defining time-travel I will not defend this claim here. In Chapter Two I will discuss the idea that our regular existence in time consists of a type of world-jumping as required by the view that the way to make sense of the passage of time whilst avoiding McTaggart's infinite regress associated with the A-theory, is to explain the passage of time as a passage of actualisation of different moments across possible worlds, as in Bigelow's (1991) and Craig's (1998) accounts. I will argue against such a notion of the passage of time in Chapter Two, §2.3.2, and world-jumping in §1.13. Thus we can, for now, reject the notion of world-jumping as a kind of time-travel, as I will argue this later.

There is a **second reason** we should not adopt Schlesinger's model of time applied to time-travel. On the Schlesinger model, people only exist at the moment in each possible world that is actual. Only one moment in each possible world is actual, and on Schlesinger's account, the moments that are actual in each possible world are successive. This means that the existence of an individual through time will be represented as a bottom left to top right, positive sloping line on our diagram of two

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<sup>13</sup> And Bigelow (1991) and Craig (1998) models.

dimensional time. This means that a non-time-traveller in Schlesinger's world exists in just the same way as a non-time-traveller exists in a world that has only one dimension of time. This presumably could mean one of two things. **Firstly**, the time-traveller is confined to the NOW-actual diagonal plane, which is akin to a one-dimensional-time time-traveller, and is hard to differentiate from merely persisting. So, while the time-traveller would be moving in two-dimensional time, he would only be moving along one plane, or to put it another way, along one line in our earlier diagram. **Secondly**, the time-traveller loses his existence, and/or his actuality, by existing in a non-present and/or non-actualised moment. I will discuss analogous cases to this latter possibility in Chapter Three.

In principle, the former may be two-dimensional time-travel. This is because the time-traveller (and all the non time-travellers) exist on one line or plane across both the B- and a  $\Sigma$ -series – it is not clear how this differs in any practical sense from one dimensional time-travel or one dimensional temporal existence. Unlike Meiland's account of two dimensional time, which accounts for the discrepancy between time and time by having two events separated more in one dimension of time than in the other, in Schlesinger's case there is no discrepancy between time and time because two events are separated from each other by the same (temporal) distance in each dimension of time. On Schlesinger's two-dimensional time model the time-traveller would be returning to the same past, and not a different past as on Meiland's model. There is thus no account of the required discrepancy between time and time. Therefore there is no difference between time-travel on this model and time-travel on a one dimensional model.

There are other accounts of two-dimensional time, but I will not pursue them as my focus here is only to explore two-dimensional time as a possible solution to the two times paradox. It seems to me that what will happen is that all accounts of two-dimensional time will either be like Meiland's, in which case they will be something like world jumping and would require such a departure from our normal conception of time-travel that they should be excluded from our definition, or, they will be like Schlesinger's account which does not differ in any practical sense from one-dimensional

time. While we could pursue this line – that there is a version of two dimensional time which accounts for the notion of a discrepancy between time and time, as well as fits with our intuitions about time-travel – I believe that we need not pursue this any further here as there is a one dimensional answer to this problem, which I think in the long run is preferable.

#### ***1.4. Personal- and External-Time Solution***

The solution that Lewis favoured is, in my view, far preferable. He employed the distinction between “time itself, *external time* as I shall also call it, from the *personal time*” of the time-traveller (Lewis 1976, 146), as a single time dimension reply to the two times paradox. On Lewis’ view, external time is chronological time, it is how we normally think of time, and in time-travel stories it occupies the place that time simpliciter occupies in non-time-travel stories and real life. In the story from §1.1, featuring Tim the time-traveller, the external time is 37 years, while the personal time is 10 minutes. According to Lewis, external time is ‘time itself’, but personal time, however, is not simply subjective time;<sup>14</sup> it is the time that the time-traveller’s watch measures, the beats of his heart, the growth of his hair, and so on. It “occupies the role” of time in the time-traveller’s life. But how exactly personal time can *play the role* of time if “[i]t isn’t really time” (Lewis 1976, 146), is unclear. I will deal with this question in Chapters Three and Five when I discuss the possibility of personal time as local time, and the possibility of local time on a causal theory of time. I will also propose a revision of the notion of personal time, based on Sider’s use in his (2005) paper, in which it is seen to be more like local time than an invented mere rhetorical device.

#### ***1.5. Why Personal-Time is important***

In his paper “Travelling in A- and B- Time” (2005), Sider argues against A-theoretic time-travel by arguing that the A-theorist cannot make use of Lewis’ personal and external time distinction. Whether or not the A-theorist can make use of the notion of

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<sup>14</sup> Unlike that suggested by the phrase “Time flies when you’re having fun!”

personal time will be discussed in Chapter Three, however, for the moment we will focus on the importance of personal time. While this was not his main goal, Sider's paper illustrates the importance of personal time in time-travel.

In Sider's time-travel story *Katy*, the time-traveller, travels back in time to view the dinosaurs. Before getting into the time machine, the time-traveller needs to be able to say that she *will* soon view a dinosaur, not that two hundred million years earlier she *did* view a dinosaur.<sup>15</sup> "Suppose that my dinosaur viewing is in no sense located two minutes in my future. Then it seems wrong to say that I *travel* in time. [If] What is true instead is that I once viewed a dinosaur ...[then]... I would be no time-traveller, only a person with a temporally disconnected lifespan" (Sider 2005, 330).

If I tell the time-travel story, be it that of *Katy* (Sider 2005) or *Tim* (Lewis 1976), by way of external time without the use of personal time then the time-travel story does not sound much like a time-travel story. For example: In 1920 a man called *Tim* (and his time machine) suddenly appears out of nowhere, spends a year or two making attempts on the life of a man he claims to be his grandfather, and then leaves via the same method he arrived by (*poof!*). Ten or so years later a grandson is born to the man who survived the attempts on his life. This grandson is named *Tim*, and as he grows up to be a young man he looks more and more like the man who made the attempts on his grandfather's life. In 1957 as a young man he builds what he claims to be a time machine, and one day (*poof!*) he disappears in, and with, this machine. A few weeks later what appears to be *Tim* and his so called time machine appear again, but with the appearance of having aged a year or two.<sup>16</sup> This story is told using external time only. It is how a stationary, non-time-travelling observer would view *Tim*'s time-travel experiences. But time-travel is not the only way in which to make sense of the observer's story, given the way it has been told here.

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<sup>15</sup> In Chapter Three I will argue that the B-theorist's time-traveller can do the former, while the A-theorist's time-traveller can only do the latter.

<sup>16</sup> In Lewis' story he does not say whether *Tim* returns to his own time or stays in the 1920s trying to kill his grandfather. Here I have told a story assuming that he does return to his own time.

Is Tim a time-traveller? Without a story about Tim's personal time we cannot know. We need personal time for two things. Firstly, we need it to be able to conceive of the story as a time-travel story. When the story is told using external time only, it does not sound to us like a time-travel story. We may think that time-travel would be the best explanation of such observations (those made in external time), but as it stands it is not a time-travel story. "According to Lewis, one *travels* into the past when the external past is in one's personal future" (Sider 2005, 334). The second role for personal time is that it allows there to be the right kind of connections between different parts of the story. It needs to be the case that grandson Tim's disappearance in 1957 is part of the cause for the appearance of the assassin Tim in 1920. And the disappearance of assassin Tim in 1922 needs to be part of the cause of grandson Tim's appearance in 1957. As well as the right kind of causal connections between certain temporal parts in the story, we need there to be the right kind of personal continuity or personal identity between assassin Tim and grandson Tim. This is because on the time-travel story they are not two different Tims, but one and the same. There is a Tim-gen-identity, a suitable person-part causal relation between person-stages, such that Tim is a maximal aggregate of person-stages so related. But note that the causal sequence does not uniformly go from past to future; instead it loops back over itself.<sup>17</sup> By telling the story by way of Tim's personal time, it not only *sounds like* a time-travel story, thus satisfying our intuitive conception of what a time-travel story should be, but it gives Tim the right kind of continuity and connectedness relations between parts – including the assassin part, and the grandson part<sup>18</sup> – in order that he have personal identity with himself over time and over his time-travel journey. In Chapters Three and Five I will employ a revision of the notion of personal time. This will be one in which it is understood as local time, as well as a genuine time series or ordering of events and not just a mere rhetorical tool.

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<sup>17</sup> How exactly this looping will look in Tim's world line will be explained further in Chapter Five when I talk about the local time, the causal theory and time-travel.

<sup>18</sup> 'Part' is used in a non-technical way here. I do not want to presuppose or imply a position on endurantism or perdurantism.

So now that we have established what personal and external time are (at least to an extent), and why they – and the discrepancy between them – are important for time-travel, let us now turn to the issue of this discrepancy between personal and external time and whether is a necessary or sufficient condition of our concept of time-travel.

### **1.6. Le Poidevin's Cryogenics Objection**

Le Poidevin (2003, 175) objects that the “discrepancy between personal and external time ... is not really adequate”. He explains that many non time-travellers also have discrepancies between their personal time and external time, simply in virtue of participating in different activities and their bodies aging faster or slower than others. This includes “The clock on the mantelpiece ... the soufflé baking in the oven” (2003, 175). To make his claim clearer, consider a more extreme case: a person who has undergone suspended animation or cryogenic freezing. I take cryogenic freezing to be one in which the bodily, including mental, processes are paused. Suppose this person was frozen for 100 years and then reanimated. The slowing down and warming up processes may take 30 seconds each, in which case the person who has undergone this processes would have experienced 1 minute of personal time compared to the 100 years of external time which they were frozen for. Yet intuitively we would not want to count them as a time-traveller. To give some real world cases, consider that there are frogs that do in fact undergo a real life version of cryogenic freezing during winter when they freeze solid inside ponds and streams (Roach 2007). Consider also hibernating bears, which Le Poidevin takes to be experiencing a slowing down of their personal time relative to the external time of the non hibernating winter world. If there is some doubt in our minds about whether the cryogenic freezing might be classed as time-travel, he then asks us to consider the following case:

*“My watch stopped 5 months ago and I still have not got around to taking it to the jeweller's to be repaired. It simply has not registered, in the way that it normally does, the passing of time. Has my watch become a time machine, then? Surely not”* (Le Poidevin 2003, 176).

The fact that something is not registering time, or registering time differently, does not mean that it is time-travelling. This shows that (on some ways of understanding what personal time is) the discrepancy requirement on its own is insufficient. The point that Le Poidevin is making is that the cryogenic freezing clearly does not count as time-travel, yet under the discrepancy requirement, it would. So this appears to be a counter example to the discrepancy requirement. In §1.11 I will present the IEE requirement which I believe captures what the problem is with these cases, and shows how some of these problems support employing my paradigm conception of time-travel. Before I do, let us consider another problematic case.

### ***1.7. The Time Dilation Objection***

While we discussed the ‘two times paradox’ as it refers to the discrepancy between personal and external time, there is another way in which the phrase is used. The ‘two times paradox’ may refer to a thought experiment in relativistic physics which is sometimes known instead as the ‘twin paradox’. (Note that this is not a paradox in any philosophical sense, it merely *seems* to be a paradox (Everett and Roman 2012, 52).) Suppose there are two brothers, twins, and one of them gets into a very fast rocket ship, while the other stays on earth. After one year has passed for the twin in the rocket ship, he may return to earth to find that his brother has aged two years, or even ten years depending on how fast his rocket ship was travelling – due to the time warp or time dilation that occurs. The physical possibility of this kind of time dilation has been experientially confirmed by the Hafele-Keating experiment (1972), in which atomic clocks on a plane were confirmed to run slightly slower due to their velocity than stationary atomic clocks on land, consistent with the predictions of special relativity. Does this count as a case of real life forwards time-travel?

Intuitively, it seems that if we want to count forward direction time-travel as real time-travel, then the time dilation of the twin paradox would be a good contender for a real

life example of forward time-travel.<sup>19</sup> If the aeroplane or space rocket on which the twin was travelling could go fast enough through space we could expect that the difference between the stationary and the travelling twin could be a significant period of time, such as 10 years (rather than the nanoseconds of the Hafele-Keating experiment (1972)). This would mean that the story of the time-dilation twin would be very similar to what we think of a forward directed science fiction time-travel story. It also satisfies Lewis' 'discrepancy' requirement – we have the discrepancy between the external time of the twin in the ship and the others who stayed on earth (which we consider the inertial reference frame), and the personal time of the other twin who travelled really very fast around the earth (experiencing time dilation). In *Time-travel and Warp Drives* (2012), Everett and Roman give a brief definition of forwards time-travel in which forwards time-travel requires “external time”,  $t$ , to “be greater than” the “the time-traveller’s own personal biological clock time”,  $T$  (2012, 12). This definition is very similar to Lewis'. They then later go on to say their twin paradox example is “just what we concluded in [their] chapter 2 would constitute time-travel into the future” (2012, 53).

It is worth restating that here we are concerned with arriving at a suitable *philosophical* account of time-travel which would capture the typical time-travel stories from our time-travel fictions. The chapter is not attempting to give a *physical* account of time-travel in the actual world. So why are we considering time-dilation cases which are a feature of the real world? We do so because, regardless of whether such cases are physically possible or not, time dilation appears to be a case that meets our philosophical definition. However, the time dilation cases present (at least) two problems for this definition of time travel, and as a result, I will later exclude them from my paradigm conception of time-travel. Let us consider these problems now.

**Firstly**, it is not clear to everyone’s intuitions that time dilation is a type of time-travel. Some people, such as Everett and Roman have no qualms about the fact that time

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<sup>19</sup> One reason some think it should not is because forwards is the direction that we travel in time anyway, in virtue of our mere spatiotemporal existence.



dilation fits their definition of time-travel. While others, such as myself and some of my colleagues in casual conversation feel uneasy about including time dilation cases, as they seem to be somewhat different from our personal conceptions of a time-travel story. Likewise, Grey (1999, 62), claims that “[t]he networks of causal separation required for time-travel involve something much more radical than the time dilation sanctioned by physics”, but does not really give a further defence. I will make a suggestion as to what this could be, in §1.11, and show how employing such a requirement produces what we think is the right answer to various cases that are time-travel contenders.

There is a **second**, or further problem for time dilation, which is stronger than an appeal to intuitions that perhaps not everyone shares. Suppose we could be seen to be travelling faster (in both space and time) than some aliens in another galaxy. Perhaps our planet Earth rotates around the sun faster than their home planet rotates. In this case our regular temporal existence would be analogous to the twin in the ship (experiencing time dilation), while the aliens – considering themselves to be the inertial reference frame – are analogous to the twin and the other people that stayed grounded on Earth. But if time dilation classes as time-travel, and we are constantly experiencing time dilation (relative to the aliens' galaxy) then it would mean that everyone on planet earth was time-travelling simply in virtue of existing in time and being on a planet that rotated faster than some other alien planet.

We can extend this problem still further. If time dilation classes as time-travel then we should consider an even trickier case than the larger scale aliens example. If two people pass each other in their cars then each of them is moving relative to the other's inertial frame, so each of them is undergoing some time dilation, even though it is minute. Any assignment of a privileged reference frame will be merely conventional or even arbitrary. Each of them is moving relative to the other's (inertial) frame, so each could

truly say that the other is travelling forward in time, assuming time dilation classes as time-travel, as we have just done.<sup>20</sup>

Yet these cases do not seem to satisfy our idea of what a time-travel story should be. Our regular temporal existence is not what we typically regard to be a case of time-travel. Time travel is something distinct from regular existence, a kind of *unusual* temporal existence. Our notion of time-travel seems to apply to the more extreme cases of time dilation – such as the twin paradox – yet clearly does not apply to cases such as people passing each other in cars or on the street. One’s first thought might be that we need to draw a line somewhere between these two cases, perhaps stipulating a requirement as to the size of the discrepancy, or the temporal distance that the time-traveller has travelled. Maybe we could say that any time-travel with less than an hour discrepancy in external time does not truly count as time-travel. But why draw the line at one hour and not at 59 minutes, or 2 hours? It is not at all clear what feature to appeal to in order to non-arbitrarily generate that demarcation line. Drawing a theoretically motivated line here seems rather hopeless.

Some might say, let us simply ‘bite the bullet’ and accept that these cases (such as our regular existence) do in fact count as time-travel, if that is what follows from our definition. But I think that a move like that is mistaken. I do not think that our definition is static, nor that it is picking out some class of things that exists objectively and independently of our intuitive notion of time-travel.

Given that the time dilation cases satisfy Lewis’ ‘discrepancy’ requirement, yet clearly not all of them can be considered time-travel cases we know that the ‘discrepancy’ requirement alone cannot be a *sufficient* criteria in our time-travel definition. I propose that we add a requirement that the time-traveller stand in a certain relationship to others. All of the non-time-travelling people living on Earth will have rather similar world lines with each other, compared to the world line of the time-traveller. The time-

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<sup>20</sup> My gratitude goes to Wolfgang Schwarz, ANU, for a discussing this idea with me (personal communication, 2013).

traveller's world line will separate from the world line of the other people on Earth in quite a distinct and different way. We do not usually envisage the backward time-traveller to simply be rewinding in time,<sup>21</sup> so we may imagine that the time-traveller goes somewhere else during his travels, and this will ensure that his world line separates from the world lines of the non-time-travellers. Therefore, rather than using a notion of an inertial frame of reference and a moving frame of reference to identify the time-traveller, we should consider his world line compared to the world line of the non-time-travellers. I will present an explanation of this, along with my 'isolation, encapsulation, and exemption' time-travel requirement in §1.11, as well as further exploring this in Chapter Five.

One might object that it is rather *ad hoc* to simply edit the definition of time-travel in order to rule out cases that we do not think of as time-travel, and hence want to exclude. I do not believe this to be problematic. This is because we are not trying to construct a scientific or explanatory theory employing scientific taxonomy, but are engaged in the project of investigating the coherence of our common-sense conception of time travel. It may be useful to discuss possibilities that are at best borderline cases of that conception, but this project requires us to fine-tune our definition to accord with that conception, not to fit the requirements of such other projects.

### ***1.8. Fast-forwarding and Rewinding***

To begin, I will clear up an ambiguity within the term 'rewinding'. I take it that there are two ways in which somebody can be understood to be rewinding in time. The **first**, is when the person who is rewinding, simply redoes all the actions that they did, but in reverse. Because *everything* in their world reverses, they are not aware of anything out of the ordinary. This is simply normal life described in a backwards way. As an example, imagine a Shoemaker (1969) type world which is split into regions. Putting aside concerns about viewing cross regionally, suppose that on Tuesday, the people in region

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<sup>21</sup> In Chapter 5, and the following section §1.8, I will give an argument as to why we are right in our intuition that the backward time-traveller is not simply rewinding in time.

one observe the people in region two as if the region two people are re-doing Monday in reverse. The events that usually happen in the order A, B, C, D, E such as having breakfast, then brushing their teeth, then heading off to work, happen in the opposite order, E, D, C, B, A. So too do all the smaller events that make up each of those events. The occupants of region two drive their cars backwards home from work, then they uneat their breakfast taking food from their mouths to their plates, then brush their teeth but making them dirtier as they brush, and so on. The inhabitants of region two seem to experience none of this, because even their mental processes are in reverse. In this first type of rewinding case, if we try to understand it as a time-travel story, we would say that the inhabitants of region two travelled to the past (Monday morning) by rewinding back to it. Then when they got there they had no recollection of having lived any of the moments later than that (Monday afternoon). I do not think that anyone has the intuition that cases like these should count as time-travel, given that they would be missing so much of what we normally think of as being involved in a backwards time-travel case, such as memory of later times (Monday afternoon), and the ability to interact with our earlier selves. I will not expand on this first interpretation anymore because I will assume that, although cases like these are *somewhat* time-travel like, we would be more inclined to call this a case of time rewinding than of time-travel. In §1.12 I will reconsider rewinding cases as types of time travel. I will also examine the notions of rewinding and backwards causation combined with time travel, again in Chapter Five.

There is a **second** way of understanding the notion of rewinding that seems a better candidate for a genuine case of time travel. This second way is more like that depicted in *The Time Machine* films (Pal 1960; Wells and Verbinski 2002). The rewinding time-travellers are not re-doing/un-doing the events that they have already done. In fact, a case of this type should perhaps not even be thought of as rewinding or unwinding in any real sense. It merely *looks* like that to any oppositely directed observers, because the supposed rewinders are going backwards or opposite the observers. Although people external to the rewinding would see those rewinding going in reverse, what is happening to the rewinding time-travellers and what they experience is not akin to that of the rewinding people in the previous case. In this second understanding of

rewinding, the rewinding time travellers feel as if they are going forwards in time even though they are travelling to the past; they do not undo any of the experiences they have had in the past, in order to return there. Rather, from the perspective of their personal time, they are doing new actions, for example, anticipating the fun they will have when they arrive at their time-travel destination.

Now we should ask whether this type of rewinding is akin to a backwards time-travel story. When we consider a backwards time-travel case we do not (usually, if ever) imagine that the time-traveller is simply rewinding in time, like in the first case. We do not imagine that he watches as the people around him appear to start acting in reverse, while to them he is acting in reverse. We imagine something more. Even if we accept that he is causally isolated from those around him and that he cannot see them nor they see him (see §1.11), we do not suppose that he is un-eating his sandwich, un-blowing his nose, or unthinking some thought. Nor do we imagine that the time-traveller experiences causation running backwards – not that he even could because causation within his mind would also be running backwards so he would not notice anything different. No, we think that *causation*, and (as I will argue in Chapters Four and Five) therefore also *time*, runs forwards for the time-traveller while he is travelling back in time. We might even think that the time-traveller somehow leaves the place where he is and travels through a different region of space-time, such as a wormhole (or ‘the strands of time’ as in *Bill and Ted* (1989)). In §1.11 I will make a proposal as to how we might make a definitional requirement out of the suggestion that the time-traveller needs to leave the place where he is in order to travel in time. I think this allows us to say that the first case is most certainly not a time-travel story. We should conclude that the first type of rewinding is certainly not a time-travel case. (The first type of rewinding was the case where the rewinders were simply undoing actions they had already done). But the second type of rewinding is far more promising as a time-travel story. (The second type of rewinding was the case where the people were doing new actions, and only appeared to be rewinding from certain points of view). However, I do not think that it is correctly described as rewinding, and more akin to a region of backwards causation and/or backwards time. If we make this second case satisfy the requirement that I will suggest in §1.11 (a requirement that the time-traveller exists in an

encapsulated region of space-time during the time-travel journey) then the second type of case will turn out to be an instance of time-travel, which again seems to match our intuitive notion. Despite the fact that the time-travellers (from the second case) appear to be going backwards to the people in external time, and hence appear to be rewinding, they are really going forwards in their local and personal time, and hence they are *not* rewinding.

With respect to fast-forwarding it seems to me that we do not usually imagine that the backwards time-traveller is simply rewinding in time. We think that time-travel involves something more (such as causal isolation, and the happening of new events rather than the un-doing of already done events). So given that, why then should we imagine that the forward time-traveller could simply fast-forward in time – as the time dilation case would seem to suggest? I think the answer is that we should not. If backwards time-travel does not involve rewinding (in the earlier, first sense of rewinding), we may wonder whether forwards time-travel involves fast-forwarding. Firstly, we should consider whether rewinding and fast-forwarding are time reversed versions of the same thing. Then we will be on stronger footing to claim that what we say about one we should also say about the other. It may be objected that rewinding is just the time reverse of regular passage through time, so the equivalent of fast-forwarding would instead be fast rewinding. I am happy to concede this and I do not think it is of great importance. But it might also be objected that fast-forwarding and fast rewinding (simply ‘rewinding’ from here on) are not time reversed versions of each other given that one is a faster version of our regular existence in time, whereas the other is not only a faster version, but also a time reversed version. This would mean that fast-forwarding and rewinding are not time reversed equivalents. Moreover, the difference between fast-forwarding and rewinding will depend on which interpretation of rewinding we are using. The first interpretation seems to be a much better contender for a time reversed version of fast-forwarding than the second interpretation does. This is because the first interpretation of rewinding is a basic redoing backwards of what has been done, but it is not time-travel, whereas the second interpretation may be thought of as time-travel, but since it introduces new events happening during the ‘rewinding’ I do not think it should be thought of as rewinding.

It might be said that fast-forwarding is merely a faster version of regular existence, whereas rewinding is altogether different from regular existence. Whether or not we think the two are time reversed equivalents will depend on the relevance we place on the direction of time. In Chapter Two I will reject the notion of an objective passage of time, and in Chapter Four I will reject the notion of an objective (privileged) direction in time – thus implying that the two directions are equally primary. It should be noted nevertheless, that nobody is denying that there are *directions* in time, because any (linear) dimension will have two directions (such as how the *height* dimension has both the *up* and *down* directions), but what is in dispute is whether one of those two directions on the time dimension is somehow the correct or, what I will call the ‘privileged’ direction. This question about the direction of time cannot be addressed here, but I will do so in Chapter Four. For the time being, let us assume that fast-forwarding and fast rewinding are time reversed versions of the same thing. This would mean that, if we are applying our principle consistently, then we should exclude fast-forwarding cases as cases of time-travel too. This would mean that we might rule out the cases of the watch with no battery, the hibernating bear, and the cryogenically frozen person, and not count them as cases of time-travel. The watch, the bear, and the cryogenic person are all cases where the passage of time is not being registered fully or properly. But we do not think this is relevant to something’s being a time-traveller or not.

Le Poidevin suggested that we may need to add a requirement of some kind of jump, or discontinuity between the time of departure and time of arrival, in terms of external time (2003, 176). Ruling out cases which contain passing through all intermediate moments (of external time) between departure and arrival time, would eliminate the problematic cases of time warp and cryogenic freezing. This is because if we were to claim that the time-traveller must pass through the intermediate moments between the departure and arrival event, they would then (in order to not be simply existing as per normal temporal existence) need to pass through these moments in fast-forwarding or rewinding manner. We are then left to include the time warp and cryogenic freezing cases that have been seen to be problematic. Likewise, Grey has claimed that “The

networks of causal separation required for time-travel involve something much more radical than the time dilation sanctioned by physics, though it may be that the chronological pluralism<sup>22</sup> of relativity softens us up for the sort of time-travel story told by Lewis” (1999, 62). We may wonder what would be a more radical kind of causal separation. Perhaps if the time-traveller actually leaves the area of space-time which he is leaving from and arriving at, and taking an alternative route through space-time, rather than travelling through all the moments between his departure and arrival event. This leads us on to the next sections, and then to §1.11 where I will present a suggestion. Also, it should be noted that while I support the idea of a requirement that the time-traveller leave the place where he is while he travels in time, I do not mean to claim that other stories where he stays in place whilst time travelling are not time-travels stories, per se. It is simply that they are not logically consistent and internally coherent time-travel stories.

### ***1.9. Continuous and Discontinuous Jumps***

The next thing that I want to consider is whether time-travel is compatible with discontinuous jumps. By ‘discontinuous jumps’ I mean the scenarios in which the time-travel event is, for the time-traveller, an instantaneous jump from the departure time to the arrival time. In such a scenario the external time would be the duration between the departure and arrival times (as seen by the non time-travellers). However the personal time of the time-traveller will be zero as there is no time taken during the duration of the journey.

There are a number of reasons why we should consider the issue of discontinuous jumps. **Firstly**, the time-traveller needs to retain personal identity with himself over

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<sup>22</sup> By ‘Chronological Pluralism’ he means multiple ways in which to order events in a time series. This is a direct result of the relativity of simultaneity. For example, observers in different places will see events as happening in different orders: person A might see the events X and Y as being simultaneous, while person B sees them as being successive. On relativity theory there is no matter of fact as to the ‘true’ ordering of the events X and Y. I discuss simultaneity and time order further in Chapter Four, §4.6.1.



time, and I think that continuous jumps will ensure this better than discontinuous, instantaneous jumps. Let me explain this. If the Tim who leaves in 1976 is not the same person as the Tim who arrives in 1920 then not only is it not *his* grandfather and not only is there no interesting grandfather paradox to puzzle over, but more importantly it is not a time-travel story. In this case it would be some other kind of science fiction story – one in which people materialise out of thin air (or out of machines which they call ‘time machines’ but which are not really). Our time-traveller needs to retain personal identity with himself during his travels to the future or past, and back again. There are many criteria that we might have for personal identity – parts of the same causal chain, the same soul, the same brain, the same body, a rope of memories (psychological continuity), and so on. But “let’s just say that there is some relation  $R$  that both suffices and is required for personal identity across time” (Keller and Nelson 2001, 338-9). If the time-traveler does not have a discontinuous jump, but instead takes some time to travel through time, and there is a positive value in his personal time, then we can without a doubt ensure his personal identity throughout the travel. This is because his world line is continuous throughout his time-travel, and the  $R$ -relation will remain unbroken. If we have a positive period of time in which the time-traveler is time-travelling, then his world line and gen-identity causal chain remains unbroken. Thus there can be a suitable chain of unbroken causal connections along that world-line, between his departure and arrival times, just like there is between the departure and arrival time of a normal person’s (or object’s) spatial travel.

**Secondly**, this leads us on to issues of causation at a temporal distance. I am going to presuppose that instantaneous jumps require there to be causation at a temporal distance. Let me explain why. It seems to me that there are three possible time-travel scenarios. In one scenario, (a), there is a wormhole or a region of local time (perhaps created by a time-machine) which connects the departure and arrival events and spatio-temporal places to each other, and which the time-traveller travels through during the time-travel event. In this scenario there is no instantaneous jump. The time-travel event ‘takes some time’ as it were; there is a positive value to personal time. This is a story in which there is no instantaneous jump, and no causation at a distance. This is the type of time-travel story that I will endorse.

In another scenario (b), there is a folding over of space time such that the departure and arrival events are not connected by some intermediate pathway (like a wormhole), but are directly touching; space-time is folded over directly on to itself. To illustrate, think of something like a lower case alpha symbol as representing a space-time worm: space-time is folded over itself and then pinched together to connect the departure and arrival events. I take it that this would be a suggestion about how we might have instantaneous time-travel without having causation at a distance. I disagree. Since I am assuming that space and time are not discrete, but continuous, I take it that at the part that is *pinched*, as it were, there *will* in fact be some path between the departure and arrival events, some albeit very small, and therefore this is not a case of instantaneous time-travel after all.

In the final scenario (c), there is no folding over of space-time at all. We simply have the time traveller disappear from the departure place and time, and reappear at the arrival place and time. This is a story that contains instantaneous time-travel and – possibly *therefore* – contains causation at a temporal distance. But I hold that it is not clear how the departure event can cause the arrival event –as it should in order for this to be a time-travel story<sup>23</sup>. Allowing for causation at a temporal distance is a questionable move given that it is a contentious metaphysical issue. The extent to which it is problematic may also depend on what model of causation we subscribe to. All things being equal, I think we should avoid causation at a temporal distance if we can. I will be assuming for the remainder of the thesis that causation at a temporal distance is highly problematic, and that therefore we should avoid instantaneous jumps and discontinuous time-travel because such cases involve causation at a temporal distance.

If we have a jump that is continuous in some way so that the time-traveller has a positive measure of personal time and an unbroken world line (such as the above case (a)), then we can say that there is a causal chain between the departure event and the arrival event which ensures that we do not need to appeal to causation at a temporal

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<sup>23</sup> More on this issue will be discussed in Chapter Three.

distance in order to have a consistent time-travel story. In Chapter Five, I will argue that given the account of time-travel developed in this chapter and specifically in §1.11, and given a causal theory of the direction of time, that backwards time-travel does not need involve backwards causation, nor causation at a temporal distance.

**Thirdly**, in the case of cryogenic freezing – which, as I explained earlier, could be seen as a kind of time-travel under some conceptions – the person being frozen does not experience any time between their freezing (or departure event) and their unfreezing (or arrival event). Their personal time will have a zero value. Were we to rule out cases with a zero value of personal time and discontinuous jumps through time then we would eliminate cryogenic freezing and other cases in which an object is not registering time – cases that we do not want to count as time-travel, such as Le Poidevin's broken watch.

While I have not strongly argued here that time-travel *necessarily* requires a continuous passage through space-time, I have shown at least that scenarios which avoid discontinuous jumps are philosophically less problematic. Adding a requirement to our definition of a continuous move through space-time, with a positive value to personal time, and an unbroken world line of the time-traveller, will allow us to have a causal continuity between the departure and arrival events; a continuity of the relation that allows the time-traveller to have personal identity over time. Without some argument as to how it can be the case that there is causation at a temporal distance; how a person can have personal identity with themselves over time when there's no R-relation or world line connecting the two parts; how it would physically work for someone to have an instantaneous jump and one personal-time-instant be spread across multiple external-time-instants, then it is not yet clear that preserving personal identity is possible. So I think given these issues the burden of proof lies with the person who wants to argue that these are surmountable. I do not want to claim that these are *in principle* impossible, just that I will not be further pursuing their possibility. Of course my definition will have to exclude some cases because not all time-travel stories (stories we might want to consider as time-travel) can be included since they are not all consistent – such as auto-infanticide cases.

Note also that while I am ruling out discontinuous jumps – jumps that do not have a positive value in personal time – I am also ruling out some types of continuous jumps, such as time dilation cases, and analogues of time dilation. It appears that time-travel requires the time-travel event to be continuous in the sense of the time-traveller’s personal time, yet it should be discontinuous from the perspectives of the non-time-travellers. As we saw from the cases of fast-forwarding and time dilation, it is not the case that someone can time-travel by moving through all the moments between departure and arrival yet simply at a different rate from non-time-travellers. Instead, I propose we require the time-traveller to leave the non-time-travellers and exist in a different region of space-time during the time-travel journey. This was mentioned at the end of §1.8 and will be discussed presently in §1.10 and §1.11.

### **1.10. Warp Drives and Wormholes**

In their book, *Time-travel and Warp Drives* (2012) physicists Everett and Roman give a definition of time-travel similar to that of Lewis. They claim that time-travel

*“really involves two different times. One we might call external time and designate it  $t$ ... The second time that enters the discussion is the time-traveller’s own personal biological clock time... Let us call this time  $T$ ... When the machine, with the Time-traveller inside, travels into the future,  $t$  will be greater than  $T$ ” (2012, 12)*

It should be noted however that this is not a definition in a philosopher’s sense as they have not said whether this is a necessary requirement of time-travel. However, it does seem that they think that it is sufficient. This can be seen by their inclusion of time warp cases and cryogenic freezing cases. Everett and Roman explain that due to their definition of time-travel (“This is just what we concluded in chapter 2 would constitute time-travel into the future” (2012, 53)), time warp or twin paradox cases are “experimental verifications” of the “conclusion that travel *forward* in time is possible” (2012, 49). They also state that cryogenic sleep, as per Heinlein’s “The Door into Summer” (1957), is “another possible mechanism for time-travel (2012, 60). Inclusion of time warp cases, and cryogenic freezing cases does in fact follow from their Lewisian-type definition of time-travel. However, this is interesting because they also claim that

rewinding cases do not count as time-travel, without realising that cryogenic freezing and time warp / twin paradox cases can be seen to be fast-forwarding cases.

More interesting for us however, is their discussion of wormholes and the conservation of energy. Initially, Everett and Roman state that discontinuous jumps through space-time are ruled out, in the actual world, by the law of conservation of energy. They point out that the mass and energy of the time machine cannot simply disappear because the total energy in the universe must remain constant in space-time (2012, 13). This would seem to be a (physical, although not logical) problem for us since I have ruled out cases where the time-traveller travels through intervening moments, as per the time-dilation cases. However Everett and Roman then go on to explain that if the time-traveller takes an alternative path through space-time, say, via a wormhole, then it only *appears* discontinuous to the observer outside the time machine. It only *appears* that there is a decrease in the universe's energy and matter. Instead, the total mass and energy of the universe remains constant because the mass and energy of the wormhole increases by the amount equal to that of the time-traveller and his machine (2012, 13-14). Thus there is no violation of the law of conservation of energy. From this it follows that taking an alternate path through space-time, perhaps via a wormhole as they suggest, will preserve conservation of energy, and therefore will be what I have called a 'continuous' jump through space-time. There are nonetheless, some problems in *physics* associated with wormholes,<sup>24</sup> but I will not attempt nor pretend to work out how this might be done, à la Morris and Thorne (1988). I want to merely accept the general notion of a traversable wormhole as one that is physically consistent with my logical analysis of the definition of time-travel.<sup>25</sup> This is because I am attempting to give a *logical* analysis of time-travel, and therefore we do not want to constrain our logical definition by real world physical possibilities and impossibilities. What the consideration of the law of conservation of energy and traversable wormholes shows, is

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<sup>24</sup> See Everett and Roman (2012, Ch9).

<sup>25</sup> Note however, that presumably not all wormholes would be instances of time travel, as Dainton notes, "To turn a wormhole into a time machine, a temporal discrepancy between the two mouths has to be created, so that passing through the wormhole amounts to taking a short cut between *times*" (2010, 143).

merely a possibility for an actual world manifestation of the logical requirements that I am presenting.

### ***1.11. Isolation, Exemption and Encapsulation***

I am now going to present what I call an Isolation, Encapsulation and Exception (IEE) condition of my definition of time-travel (or at least a condition of the definition of *my paradigm case* of time-travel). The IEE requirement will be the principle by which we demarcate cases of time-travel from those that are not. I will show that when we apply this requirement to the various cases we considered earlier in the chapter, the IEE requirement gives us the same conclusions as those which I drew about the earlier cases. The answers that the IEE condition gives to the cases will be in keeping with the conclusions that I have reached when we considered them earlier. For example, I will show that the IEE condition is not satisfied in the case of time-dilation and therefore time dilation should not be counted as a type of time-travel. I believe that the IEE requirement picks out the crucial features of time-travel cases, and highlights what is missing from the cases that are not time-travel. So let us now consider what this IEE requirement involves.

**Isolation** should be understood as when the space-time region that the time-traveller is within is causally isolated from the region of the non-time-travellers (at least during the time-travel event – presumably we want the regions to become un-isolated at the departure and arrival times of the time-traveller). The time-traveller and all the things inside his region are **exempt** from normal, default laws of nature, *so far as relations between the capsule (wormhole, or similar) contents, and the remainder of the universe are concerned*. What is going on outside the time-machine is not causally interacting with the goings-on inside the time-machine, and vice versa. I do not mean that there is any exemption to the laws of nature inside the time-machine, nor outside of the time-machine. There are no violations of the laws of nature. What I mean is that there is a barrier (this is the isolation) which means that the laws of nature are carrying on as per usual outside the time-machine and inside the time-machine, but what is going on inside is exempt from what is going on outside, and vice versa. One example of this is

that outside the time-machine causal chains will be going in one direction, while inside the time-machine causal chains will be going in the opposite or backwards direction, and there is no interaction between these causal chains during the time-travel event. An analogy could be made with gravity on earth and on the moon. The moon is exempt from the force of gravity at  $9.807\text{m/s}^2$  (what it is on earth) but that does not mean that the moon is violating any laws of nature. Rather, gravity works differently on the moon as a result of contingent facts about the moon combined with the laws of nature themselves, making the force of gravity on the moon  $1.622\text{m/s}^2$ . (However, in the case of the moon, there is no isolation and encapsulation like there is in the time-travel case, so the cases are not analogous in that respect).

**Encapsulation** is the setting up of a physical boundary within which all the contents maintain what appear internally to be more or less normal causal and law-governed relations to one another. It is not as if causation and laws of nature apply differently inside than they do outside the time-machine, it is just that they may be expressed differently because the time-machine is in (or is itself) a locally isolated and encapsulated region of space-time.

An analogy with Shoemaker's (1969) *Time without Change* tripartite world might be helpful here. In Shoemaker's story, one of the spatial regions will be frozen (there is no change) while in another spatial region events carry on as normal, as it were (Whether or not time can pass in a frozen world with no change is the issue Shoemaker is trying to explore). During the freezing period the frozen region is isolated from the causal (and other) relations and events outside of the frozen region.<sup>26</sup> Shoemaker's story does

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<sup>26</sup> Although presumably the region is not entirely causally isolated and encapsulated because the people in non-frozen regions can observe that one region is frozen. This indicates that there are at least causal interactions with light-waves between a frozen and a non-frozen region. This is suggested by the following: "During a local freeze all processes occurring in one of the three regions come to a complete halt; there is no motion, no growth, no decay, and so on. At least this is how it appears to observers in the other regions." (Shoemaker 1969, 369) However, I take it that this is problematic (as also mentioned in §1.8 and §5.1) and that we should think it as a mistake that that can be light-waves passes between the regions and that viewing is possible.

not necessarily commit us to any particular view about laws of nature (such as lossy laws, or certain regions being counter-nomic). Laws will be expressed differently in different regions due to certain contingent facts about certain regions. And so it is with gravity on the moon and on the earth: contingent facts about the mass of the earth and of the moon will affect how the same laws are expressed.

Now let us consider the **cryogenic freezing** example, and apply the IEE requirement to that case. What might count as genuine cases of cryogenic freezing is not going to be discussed. This is because cryogenic freezing is not something that is (currently) a physical possibility, and because this chapter is devoted to conceptual analysis of *time-travel* and not of cryogenic freezing. So, given that we are remaining somewhat vague on what cryogenic freezing actually is, there are a number of things that *might* be going on in the cryogenic freezing case. Perhaps the frozen person is wearing clothes that are damaged by the cold: the cryogenic process would leave extensive traces on their clothing so their state of preservation would not be matched by their clothes. Likewise, on the assumption that (in the actual world) radioactive decay is not halted by extremely cold temperatures, the mix of radioactive isotopes in the person's body would still be registering time in some way. Likewise for the watch example. While the watch is not registering time in the way that is intended to (i.e., hands ticking), it is still registering time in that the silver tarnishes, the cogs deteriorate and so on. But when we employ the IEE requirement, it becomes obvious why these cases fail to be time-travel stories. Causation and the laws of nature are continuing as they do in the rest of the world, it is just that some of the processes are slowed. The supposed time-traveller (the frozen person, or the watch) is not encapsulated in a region in which they are existing while they undergo their freezing; their time-travel-like process.

In §1.8 I claimed that the **fast-forwarding and rewinding** cases fail to be time-travel because the supposed time-traveller does not leave the region in which the non-time-travellers exist. The IEE requirement captures why this matters. Likewise for the **time warp / time dilation** case, which is simply a real-world instance of the more general fast-forwarding case. In time-travelling cases, as normally conceived, there seems to be a sharp separation between how the laws that govern what is going on within the



encapsulated system are expressed, and the how the laws governing other systems in the world are expressed – the IEE requirement can account for this. But the time dilation case is not like that. For instance, the rocket ship may be in radio communication with the earth the whole time. A single set of laws simultaneously covers everything that is going on inside the rocket ship and on earth. The rocket ship that is undergoing time dilation is not in any way encapsulated and separate from the non-time-travellers on earth. The IEE requirement means that we do not have to draw the theoretically motivated, but arbitrary, line that we were hoping to avoid in §1.7. Rather we can appeal to some tangible physical difference between the time-dilation-like cases that count as time-travel, and those that do not.

The IEE requirement also encompasses the requirement that there be no **discontinuous jumps**. If the time-traveller is in a region of space time which is causally isolated and encapsulated from the place of his normal temporal existence, then it is possible to ensure that he does not undergo a discontinuous jump as part of his time-travel.

### ***1.12. The No Discrepancy Objection***

Now I want to consider another problem which may show that the ‘discrepancy’ requirement is not necessary after all, because we can think of a scenario which we probably *do* want to consider a case of time-travel, yet it does not appear to satisfy the discrepancy requirement with two different times between departure and arrival. Smeenk and Wüthrich claim that Lewis’ discrepancy requirement is neither a necessary condition, nor a sufficient condition. They state, “Presumably, Lewis and everyone else should want to include a case when the time lapse between departure and arrival equals the duration of the journey but the arrival occurs before the departure” (2011, 580). They go on to defend the possibility of time-travel combined with general relativity and quantum gravity, but do not discuss time-travel definitions beyond this comment, thus I will discuss my own examples rather than theirs.

Suppose that someone takes five minutes to travel back in time five minutes, in which case there would be no discrepancy between personal and external time, yet due to their travelling backwards in time we would not want to rule them out as a time-traveller. I propose that there are two ways that we might conceive of this case, one in which the time-traveller stays in the general area of space-time (such as a park) that they are in prior to, and after, the time-travel event. The other, in which they seem to disappear during the time-travel process. Note that these two cases are exactly alike except that in the second one, the time-travel part of the journey is not visible to the outside world – it is isolated and encapsulated. Note also that these cases are akin to the second case described in the section on fast-forwarding and rewinding. The second case from §1.8 is the case that I suggested should not properly be understood as rewinding since during what appears as the rewinding period, the agent is actually undergoing new actions, rather than undoing the same actions. It is this case that I will talk about now.

We are going to consider an illustration of rewinding time-travel as set out under the second interpretation from §1.8. In the second interpretation of rewinding time travel, the (supposed) time traveller does not, in their personal time, undo the events that are in their past in external time. Rather, they undertake new events during the backwards time-travel event. When we consider two ways of conceiving of a case that does not meet the discrepancy requirement, I mean both cases to be types of this *second understanding* of (what is not really) rewinding from §1.8.

Consider a case in which I am walking across a park (as it happens, there is somebody walking *backwards* towards me – but forget that for a moment). When I reach the middle of the park after three minutes, for whatever magical reason (perhaps I am in the possible world of Harry Potter), I start to travel backwards in time, or, relative to my observations, everyone else around me starts to travel backwards in time. While this local time reversal is happening, I continue to walk to the far end of the park. It takes me two minutes to get there. Then, again by some magical feat, time returns to normal, and I within it. Let us consider what an observer on a park bench would see. I will make use of a diagram on which the x-axis represents one dimension of space (each end

of the park) and the y-axis represents external time (see figure 4). The arrow inside the diagram will represent my personal time, and space-time worm.

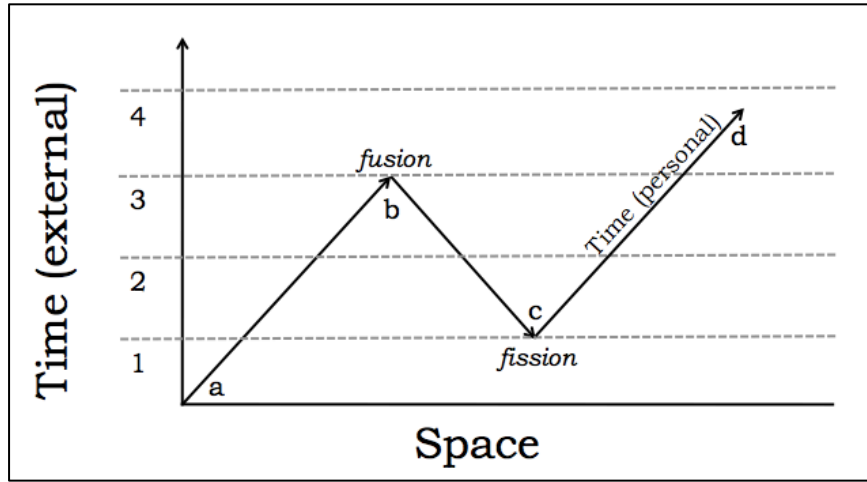


Figure 4: Non-absent, rewinding time-travel in park.

After one minute into my journey walking across the park, on the other side of the park an observer would also see two other ‘me’s undergoing apparent fission out of nowhere (at point space-time point *c*)! One of which (the *c-b* part of my space-time worm) will appear to walk backwards across the park as if acting in reverse, while the other (the *c-d* part) walks across the park and leaves at the far end. The observer would see the backwards, *c-b* portion of me walking to the centre of the park and then merging into one with the *a-b* portion of me – undergoing apparent fusion, at space-time point *b*! At two minutes into my journey across the park, the park bench observer would see three of me – the *a-b* portion, the *b-c* portion, and the *c-d* portion because they all exist at the two minutes mark. Yet in truth, there is just one of me made up by the space-time worm that goes from *a-d*, and the observer is seeing me at three different parts of my personal time yet at one moment (the two minutes mark) in external time. It should also be noted that while the observer sees me undergo what appears to be person fission (point *c* at one minute into my journey) and then person fusion (point *b* at three minutes in), nothing of the sort is going on from the perspective of my personal time. My personal time places the events in the order *a*, *b*, *c*, and *d*. To the observer, they see *a*, *c*, *b*, and *d*, as ordered by external time. So this is one way in which we might conceive of a time-travel case in which there is no discrepancy between the duration of

the journey (my personal time) and the departure and arrival times (external time). This is because during the  $b$ - $c$  portion of my journey I travel back in time two minutes in external time, but it takes two minutes to get there in personal time. So that is the first scenario. Before I discuss this further I want to present a second scenario, then turn to discussing them together.

In this second scenario, instead of me reversing in time via some sort of magical event like the previous example, suppose that a worm hole opens up and that I get sucked into it for two minutes and appear back in the park two minutes earlier than when I left. In this case the observer would not see my backwards travel – they would not see the  $b$ - $c$  portion of me – and neither would they see the person fission or the person fusion. They would just see my appearing at  $c$  and disappearing at  $b$ . Instead of seeing three of me, two minutes into my journey across the park, they would see only two of me – the  $a$ - $b$  portion and the  $c$ - $d$  portion – the two that are travelling forwards in time as per normal.<sup>27</sup>

Both of these cases seem to satisfy our pre-theoretic conception of time-travel, yet they may not satisfy Lewis' requirement of a discrepancy between personal and external time. This is because the time-traveller used two minutes of his personal time in order travel two minutes backward in time. So these two cases appear to be counter examples to the 'discrepancy' requirement, and we may therefore have to remove this requirement as a necessary feature of time-travel. However, there is a response that can be given, with two parts.

The first part of the response requires us to employ the IEE requirement from the previous section (§1.11). I will show what the IEE requirement would allow us to say about this case, and why I think the IEE requirement accounts for (what I take to be) our intuition in this case. We can concede that such a case classes as an instance of my paradigm case of time-travel if it meets the IEE requirement, despite perhaps not meeting the discrepancy requirement. If somebody has travelled (back or forward) in

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<sup>27</sup> Monton (2009) has a similar story.

time via an isolated, encapsulated, and exempt region of space-time, despite taking the same amount of time to get there as there is between the events in external time (i.e., despite the personal and external time durations between departure and arrival are equal), then we can say that they have time-travelled. But what about the first scenario in which the person does not leave the park? That case would be ruled out by my IEE requirement. This is where we employ the second part of the response. Although there is no discrepancy in terms of duration, there is a discrepancy in terms of the sense/direction/order of the events between  $b$  and  $c$  in personal time and external time. In both of the park scenarios of time-travel the events are ordered in external time  $a, c, b$ , and  $d$ , while in personal time they are ordered  $a, b, c$ , and  $d$ . If we require that the discrepancy be not necessarily in duration, but that it can be in terms of direction ( $b-c$  versus  $c-b$ ) then we can include the first scenario in the park as one of time-travel. This means that we can still classify backwards directed stories as time-travel stories, but we do not have to include forwards directed cases that do not satisfy the IEE requirement, such as time dilation. This is because while there is a discrepancy in terms of duration, time dilation cases do not satisfy the IEE requirement, nor do they satisfy the requirement of a discrepancy of oppositely directed personal time. So we can say that the IEE requirement and the requirement of a discrepancy between sense/direction of personal time and external time are both individually sufficient for time-travel. If we do not want to count the first scenario as time-travel (the scenario where the time-traveller is present during the time-travel journey) then we can reject the sense/direction understanding, rather than the duration understanding, of the discrepancy requirement. So that is what we could say about this case if we employ the IEE requirement of time-travel. It seems to me that the IEE requirement accounts for our intuitive answers in the cases of no discrepancy.

### ***1.13. Time-Travellers as Observers or Agents***

We will also want the definition of time-travel to exclude cases in which the time-traveller is a mere observer of the time that they have apparently travelled to. This is because if we think of a time-traveller as merely observing another time but not being an agent in that time then it is not clear whether we should say that they have really

travelled to that time at all. For example, when we watch a film we are not able to causally interact with the world inside the film in the same way that we do with the reality outside of the film. Of course we can causally interact in some ways with the film – we can hear what is being said, we can see what is being done, we have emotional responses to events in the film. But there is not a two-way interaction between the film and the viewer, because the viewer really is only a *viewer*.

The kind of cases that I have in mind here are those suggested by Harry Potter's use of Dumbledore's Pensieve, a memory storage device (Rowling 2000), and Scrooge's experiences with the Ghost of Christmas Past (Dickens 1843). In these stories the agents cannot causally interact with the pasts that they are experiencing, they are mere *viewers* of these events. Harry Potter and Scrooge are no more time-travelling than you are when you watch a video of your vacation last Christmas. Maybe in some weak or figurative sense of the word you are time-travelling – your *mind* might be returning to that time; but not in any literal sense. Your mind is simply reflecting on what happened in another time. This is no more past directed time-travel than imagining your next birthday is forwards directed time-travel.

#### ***1.14. Changing the Past, and Vranas' supposedly Novel Account.***

It is often accepted that there is no such thing as changing the past in time-travel stories, because they commit what is called the second-time-around fallacy. Since we are defining what classes as time-travel and what does not, I want to include what may be seen as somewhat of a digression from the consideration of necessary and sufficient conditions, in order to consider why we should not allow for time-travel stories that include the possibility of changing the past. Specifically I will consider an argument given by Vranas (2005) for the possibility of changing the past. I take this argument to be a consequence of a misunderstanding about the nature of Lewisian possible worlds, a consequence that I therefore want to rule out from my definition.

Vranas defines changing the past:

*“I change the past exactly if I perform now an action which makes the past qualitatively different from what it is. More generally, for any times  $t^-$  and  $t$  such that  $t^-$  is not later than  $t$ , at  $t$  I change the past of  $t^-$  exactly if I perform an action which makes the past of  $t^-$  different from what it is.” (Vranas 2005, 372)*

Consider how we usually think of changing the past:

*“(P1) There is a possible world  $w$  in which, at some time  $t$ , I perform an action which makes the past of  $t$  in  $w$  different from what the past of  $t$  in  $w$  is.” (Vranas 2005, 373).*

This understanding commits what is often called the second time around fallacy. It allows the past to contain both  $p$  and  $\text{not } p$  – a logical contradiction – because we think of the time-traveller as having a second chance at a past that is normally out of one’s reach. However although the time-traveller may be experiencing the past for the second time, there is still only one past. Whatever is/was the case in the past will always be the case. The past of a world  $w$  at some time  $t$  cannot be different from the past of  $w$  at  $t$  – from itself. Vranas’ new understanding of changing the past does not regard ‘the past’ as a rigid designator – as referring to the past of the actual world only. Instead, suppose that we may consider the past of a possible non-actual world instead. Vranas formulates this concept as follows:

*“(P2) There is a possible world  $w$  in which, at some time  $t$ , I perform an action that makes the past of  $t$  in  $w$  different from what the past of  $t$  in  $\alpha$  is” [ $\alpha$  represents the actual world] (Vranas 2005, 373)*

Let us understand Vranas’ P2 account of changing the past as that an agent performs an action in a possible world, which makes the past of that possible world different from the past of the actual world in which he did not perform that action. To illustrate, let us use Vranas’ example: suppose there is a possible world in which Vranas’ counterpart goes back in time and suggests to his earlier self that he should *not* confess his love for a woman. As a consequence of his suggestion his earlier self does not. The past of *that* possible world is different from the past of the *actual* world, in which Vranas is not a time-traveller and thus does *not* suggest to his earlier self not to confess his love for the woman, which results in Vranas’ younger self confessing his love. In the non-actual possible world, counterpart Vranas has performed an action at  $t_3$  (such as getting into the time machine) that was part of the causal chain, which lead to him

performing an action at  $t_1$  which, in turn, was part of the causal chain that led to an event at  $t_2$ . And that event at  $t_2$  in the possible world is different from the events taking place at  $t_2$  in the actual world. In summary, there is a counterpart Vranas who has caused the future of  $t_1$  in the possible world to be different from the future of  $t_1$  in the actual world. So long as one accepts possible worlds and modality in some form or another and does not deny talk of possible world nor is a hard determinist, then the possibility of one's counterpart in a possible world doing something different from what oneself does in the actual world, is non-problematic.

Let us now consider some examples that Vranas uses to illustrate his account of changing the past. Vranas asks us to consider an analogy with the future, or with *changing* the future. Suppose Vranas “will in fact die under torture in 2025” (Vranas 2005, 373). Perhaps he has time-travelled there and so he knows this, or perhaps not, Vranas does not say. Suppose also that Vranas commits suicide in 2005, thus preventing his death by torture. About this situation Vranas says:

*“I would bring about a non actual future, a future in which I don’t die under torture, contrary to what happens in the actual future. It’s true that in another sense, which corresponds to transforming [the second time around fallacy sense], I would not change the future: I would not make the actual future different from the actual future”* (Vranas 2005, 373-4)

We could understand Vranas as making the counter-factual claim that there is a world in which Vranas commits suicide in 2005 thus preventing the possible future where he is tortured to death in 2025. But in *that* world it is *not* also a fact that he is tortured to death in 2025, instead that is a fact of *another* possible world, a world in which he does not commit suicide in 2005. There is no single possible world in which Vranas both dies under torture in 2025 and also does *not* die under torture in 2025 (but rather commits suicide in 2005). Thus I hold that it cannot be a future fact that Vranas “will in fact die under torture” but also that he prevented it by killing himself in 2005, and Vranas is mistaken to claim as much. At most, Vranas can make a *counter-factual* claim that he *would have* died under torture in 2025 had he not killed himself in 2005. So given that, We may wonder what Vranas means when he claims that if he commits suicide in 2005 he would prevent what he calls the ‘fact’ that he dies under torture in



2025, and thus he “brings about a non-actual future”. At most Vranas can mean that there is a possible world in which his counterpart brings about some action – namely suicide – which makes it the case that he does not die under torture in 2025. So Vranas’ counterpart has performed some action that has made it the case that counterpart Vranas brings about a non-actual future. But of course, to counterpart Vranas, it is *his* actual world future.

What we must not do is understand Vranas as saying that actual world Vranas has performed some action that has brought about the non-actual future of another possible world. Possible worlds are to be understood as spatiotemporally isolated from each other. It is not possible for actual world Vranas to perform any action that has a causal influence on the possible world’s future, such as actual world Vranas making it the case that possible world Vranas does not die under torture.

Another thing that we must not do, without argument at least, is to think of possible worlds as branching. On the standard understanding of possible worlds, it is *not* the case that at any point there are many possible futures, and that every time an agent makes a choice or an event could have happened two or more ways; that the possible world branches. Instead it is the case that the possible world was actually two or more distinct but indistinguishable possible worlds, until they diverged. Thus we should *not* interpret Vranas as saying that while at a given point it is a future fact that he dies under torture in 2025, he *can* perform an action now in 2005 (such as suicide) which in some sense prevents his death by torture because his world line branches and goes off in a different direction. Although the future may be un-actualised in the sense that we have not yet experienced it (on a B-theoretic, Eternalist picture), a future is either actual in virtue of being the future of the actual world, or it is un-actual in virtue of being the future of a merely possible world. Unless one adopts a branching view of time – a kind of dynamic Eternalism<sup>28</sup> – the future is *not* one of many possible futures that are yet un-actualised. And even then, on a Branching world account, it is not the case that one

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<sup>28</sup> In §2.1. I will discuss classification of views on time.

can *change* the future. Rather, there are many possible futures and the actions we undergo in the present determine which branch will become actualised in the future.

Let us now consider another example to illustrate Vranas' account. Unlike the previous example which was about changing the future, this example is an example of changing the *past*.

*"If I were to visit 1965 by time machine and induce my mother's obstetrician to perform a successful caesarean section on my mother, it is natural to say I would change the past: I would change the (time and) manner of my birth. I would change the past in the sense of replacing it: I would bring about a non-actual past [...] contrary to what happens in the actual past."* (Vranas 2005, 374)

Time-travelling Vranas would not change the time and manner of *his* birth because it cannot be the case that he was both born by natural birth, and *not* born by natural birth (but by caesarean section instead). Since that would be a logical contradiction, it would commit the second time around fallacy and reduce changing the past to the (P2) kind that Vranas agrees is contradictory. At most, what we can say about this situation is that if actual world Vranas was born by natural birth then there is a possible world in which counterpart Vranas time-travels back to just before his own birth and convinces his mother's obstetrician to perform a caesarean, thus making it the case that he was born by caesarean section. However, in that possible world it will have always been the case that an adult Vranas would have time-travelled back in time and been part of the causal chain that lead to his mother giving birth to his baby-self via caesarean section, rather than natural birth. And so it seems that this is not a case of changing the past, but rather a case of what Vranas calls 'affecting' the past; when a time-traveller is non-problematically part of the causal chain that leads events in the past to be what they always were.

As mentioned with regards to the previous example which featured Vranas' death rather than birth, we must *not* interpret Vranas as saying that he can perform some action in one possible world, such as getting in his time machine, which brings about a non-actual past; i.e. the past of another possible world, a possible world that is not actual to him. Certainly, a non-actual Vranas can perform an action which brings

about a non-actual past. An example of this was presented above where time-travelling Vranas was always part of the causal chain which lead to his caesarean section birth. But no Vranas in any world can perform an action which brings about the past, present or future of another possible world. As mentioned earlier, possible worlds are thought to be spatiotemporally isolated from one another and so, without some argument or reason otherwise, we should not deviate from that understanding.<sup>29</sup>

Vranas is correct in claiming that there is a possible world in which his counterpart travels back in time and convinces his (counterpart's) younger self not to confess his love for this woman. Vranas is also correct to claim that there is a possible world in which his counterpart travels back in time and convinces his (counterpart's) mother's obstetrician to perform a caesarean section. But these are simple modal claims. In no situation is it the case that the past (or present or future) of the actual world is somehow inserted, swapped or replaced with that of a possible world.

In order to consider the claim that Vranas can change the past, let us consider Lewis' 1976 case of time-travelling Tim. Tim returns to the past to kill his grandfather before Tim's father was conceived. Were Tim to succeed in killing his grandfather he would cause himself to not exist, and therefore he would not travel back in time to kill his grandfather after all – which would be a logical contradiction. Another, less complicated logical contradiction would ensue were Tim to kill his grandfather: it would both be *and not be* the case that grandfather died in 1921. Yet Lewis argues that despite this, there is in fact a sense in which Tim *can* kill his grandfather. Lewis points out, using his non time-travelling character Tom, that in normal life one does not consider future facts – such as the fact that Tim and Tom's respective grandfathers do not die till the 1950s – to be relevant when assessing their ability in 1921. There is a possible world in which non-time-travelling Tom *does* kill his grandfather, despite that fact that in the actual world he does not. Thus we can make the counterfactual conditional claim “If  $\varphi$ , then Tom would/could have killed his grandfather” (where  $\varphi$  refers to any antecedent that results in the consequent). Time-travelling Tim, too, can

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<sup>29</sup> See Dempsey (2014) for such an argument.

kill his grandfather, if we appeal to the appropriate counterfactual claim. We cannot hold all else fixed and allow that Tim kills his grandfather. As Lewis himself says, “the thing to do is rather to make the counterfactual supposition and hold all else *as close to fixed* as you consistently can.” (Lewis 1976, 152. Emphasis added). So we should consider what the closest possible world is in which Tim does kill his grandfather with no logical contradiction. In this world Tim might mistakenly think he is a time-traveler, or, he might kill someone else’s grandfather, or his grandfather might be resurrected after death, and so on.

Lewis’ case of Tim the time-traveller is analogous to Vranas’ time-traveller cases. There is a possible world in which Vranas goes back in time and convinces his younger self not to confess his love for the woman, thus we can say that it was possible for that to happen. Yet we must also quantify this counterfactual claim with the appropriate antecedent. It cannot be the case that Vranas both does and does not confess his love for the woman – that happens in no possible world. The possible worlds which include Vranas preventing his younger self from confessing his love are worlds in which he never confessed his love, but in which older Vranas might *misremember* his younger self confessing his love, or perhaps he only *thinks* that he has prevented his younger self from confessing his love, and so on. There are a number of other stories which are consistent with an older time-travelling Vranas convincing his younger self not to confess his love.

Now that we know what time-travelling Vranas can in fact do, we must ask whether this counts as changing the past. Vranas appeals to an extract from Lewis which he believes shows that Lewis is also of the opinion that the agent is therefore able to change the past. This because in the extract there is a possible world in which an counterpart agent did differently than what the actual agent did.

*“What you can do is to change the present or future from the un-actualised way they would have been without some action of yours to the way they actually are. [...] That is something like change. [...] But it is not literally change, since the difference we make is between actuality and other possibilities, not between successive actualities. [The time-*

*traveller] changes the past from the un-actualised way it would have been without him to the one an only way it actually is. (Lewis 1976; 150, as cited in Vranas 2005; 376)*

Vranas then claims that in this extract “Lewis is talking about replacing a *non-actual* with the *actual* past” (Vranas 2005, 376). But Lewis is not talking about *replacing* anything, he is merely making a counterfactual claim that one could have performed a different action, or that the world would be different without that action.

Vranas presents an argument for his claim that replacing the past classes as changing it. He gives two analogies which are cases of replacement yet are also cases of change, in order to show that *replacing* the past in his (P2) sense *does* count as changing the past. The first example involves a light bulb. Vranas ‘changes’ the light bulb in his bedroom when he replaces it for another light bulb. He has not *transformed* the first light bulb into the second – transforming being the term he uses for a (P1) understanding of changing – but rather, he has *replaced* it. But according to Vranas, this classes as a case of ‘change’. Vranas also uses an analogy with the government ‘changing’. A government has ‘changed’ when one party moves out of power and another in. The party that were in power did not transform into another party thus making it the case that the government ‘changed’. Instead, one party was replaced by another. Vranas claims that if we can say that we changed the light bulb in the bedroom by replacing it with another, then we can also say we change the *past* by replacing it with another, and thus replacing the past does count as changing it. However, Vranas’ analogies fail.

In the light bulb case one light bulb is being removed and another light bulb fills its place. ‘The light bulb in the bedroom’ was a description or title which belonged to one light bulb, and then to another. So the thing that classes as ‘the light bulb in the bedroom’ has changed. Let us call this light bulb case (a). Now consider another slightly different light bulb case (b). Suppose we move our attention from ‘the light bulb in the bedroom’ to ‘the light bulb in the kitchen’. It is no longer a clear case of change. Certainly we have changed which light bulb we are considering – the one in the kitchen or the one in the bedroom – but nothing about the light bulb or what is in the light bulb’s place has changed, except for perhaps the description ‘the bulb I am focussing on’. The same can be said in the case of one political party moving into power and

another out, and the description ‘the New Zealand Government’. In that case we can say that something has changed in the (a) sense, one party has filled the position of power that the other party had filled. But when we move our attention first from ‘the New Zealand Government’ to ‘the Australian Government’ this is analogous to moving our attention from one light bulb to another, in the (b) sense.

Vranas thinks that his conception of replacing the past is analogous to light bulb example (a) and to government example (a). However, it is instead analogous to the light bulb and government examples (b). This is because it is not the case that one past has been removed from the ‘past’ placeholder in the actual past and been replaced by a possible world’s past, in the same way that one light bulb was removed from its place in the bedroom light socket and replaced by another. Instead we are focussing our attention from ‘the actual world’s past’ to a ‘possible world’s past’, just like when we move our attention from ‘the bedroom light bulb’ to ‘the kitchen light bulb’, or from ‘the New Zealand government’ to ‘the Australian government’. We cannot, in the example (a) sense, say that what classes as the past has changed, instead what has changed is ‘the past I am considering’. But *which* past classes as ‘the past I am considering’ is merely arbitrary. Thus it would seem on Vranas’ account that the only sense in which we can change the past is by changing the past that we are considering. Therefore, in answer to Vranas’ question, it would seem that there is, after all, still no use in crying over spilt milk, confessed love, and so on – unless one can somehow take comfort in the fact that there is a close possible world in which the milk was not spilt and the love not confessed. Although, personally, I do not find that comforting!

### **1.15. Chapter Conclusion**

Some people (such as Everett and Roman) may want to count cryogenic freezing and time warp cases as time-travel. Despite meeting the ‘discrepancy requirement’ these cases face other problems. Problems include: a slippery slope argument, the issues highlighted by considerations of fast-forwarding and rewinding cases, and the fact that the supposed time-traveller goes through all the intervening moments of time. I do not want to say that the intuitions of people who count these cases as time-travel stories are

wrong, however. I merely want to claim that they are not logically consistent or internally coherent. So, from now on I will call such cases *weak* time-travel cases, those that satisfy the ‘discrepancy’ requirement, but suffer what I take to be other problems or deficiencies, such as not meeting the IEE requirement. I will therefore make a distinction between *weak* and *strong* time-travel cases, due to meeting either the basic requirements for time-travel only, or the more stringent requirements for my paradigm conception of time-travel that I have outlined.

Cases that I consider *weak* time-travel cases are those which meet the discrepancy requirement but face other problems. For example: those with instantaneous jumps in personal time and do not have the departure and arrival event as contiguous, and which therefore require causation at a temporal distance; those that merely involve a fast-forwarding or rewinding of time, such as the time warp cases; and those that involve a non-registering of the passage of time, such as cryogenic freezing or hibernating bears.

On the other hand, the features that are required for a case to satisfy my *strong* notion of time-travel are those in which, not only is the discrepancy requirement met, but there are no instantaneous jumps. These are cases where there is a positive value to personal time, and therefore causation and personal identity can be easily preserved across time. As I have shown, I believe that time-travel which uses a method such as a traversable wormhole is one which best preserves the requirements for *strong* time-travel, for my conception of a paradigm case of time-travel. However, a traversable wormhole is merely a possibility for an actual world instantiation of the IEE requirement, and as this is a *conceptual* analysis of the notion of time-travel. It bears repeating that I do not intend to commit us to any particular, physics-informed account. Such a notion of time-travel – one that employs the IEE requirement as a necessary condition of time-travel – will be the one that I will employ in the following chapters of the thesis.

In this chapter I have brought to light some of the issues that arise in considering an appropriate characterisation or definition of time-travel. I do not claim to have solved

these problems or finished the work that needs to be done here, but merely to have introduced some of the issues arising, and motivated my paradigm account. My extended discussion of these issues in this chapter is an original contribution to the philosophy of time as, while there are many mentions of time travel as comments in passing, little to no work that has been done on these questions in any depth.



*“It is just an illusion we have here on Earth that one moment follows another one,  
like beads on a string, and that once a moment is gone it is gone forever.”*

*– Kurt Vonnegut*

## 2 The A-theory and its Discontents

This chapter has two main aims. **Firstly** I will explain the difference between the A- and the B-theories on time – those that accept the passage of time as an objective feature of reality, and those that do not. I will also present what might be seen as a slight modification of the way in which we classify views of time, specifically with regards to ‘Eternalist A-theories’, and of how we define the terms ‘Eternalism’, ‘A-series’ and ‘B-series’. Given that there appears to be no single standard of usage of these terms I will explain how I will be using the terms, and give a short defence of such usage. But I will also make a normative claim: I will show why we should understand the differences between views in philosophy of time to be in terms of *two* dichotomies and not one, namely, realism or antirealism about objective passage and about the existence of moments in time. This has not always been made explicit in the philosophy of time. I hold that the schema that I am employing is optimal because it helps us to better make sense of the world and of the dialectic in philosophy of time. The representation of this classification system will be the first of my original contributions within this chapter. **Secondly**, I will then present a number of insurmountable objections to the A-theory. My aim is to show that the A-theoretic notion of an objective, moving or passing NOW is inherently contradictory and that all A-theoretic views will face objections. This chapter will cover problems for the A-theory *simpliciter*, and the following chapter will build on those to then present some problems for the A-theory *combined with* time-travel. The objections that I will present in this chapter will primarily be a defence and discussion of objections that other philosophers have already made. My second original contribution in this chapter will be to show that many objections to A-theoretic views are analogous to the problem posed by what is known as McTaggart’s Paradox, and that many possible solutions to the problems posed for the A-theory will fail by falling into an analogue of McTaggart’s paradox. I will begin by setting up the notions of the A- and B-series and the A- and B-theories, and I will then focus on McTaggart’s explication

of the A-series and the contradictory properties and infinite regress which the A-series faces ('McTaggart's Paradox'). I will then consider Presentism as a response to this problem. This will lead into a discussion of "the problem of temporary intrinsics" and a modal interpretation of Presentism (Many/Possible Worlds Presentism). I will show that Presentism does not avoid McTaggart's Paradox after all. I will also present Price's exposition of the need to employ second (and then third, and then fourth, and so on) temporal parameters in order to make sense of the passage of time in Broad's Moving Spotlight view – another objection which I believe is analogous to McTaggart's Paradox. I will then show why employing a notion of super-time is not available, and I will discuss how this ties in with another objection, which I will call the 'Is it now, now?' problem. I will also present two other problems for the A-theory which do not tie in with McTaggart's Paradox as such, namely, Price's explication of the problems that arise from our question of the rate of time's flow or passage, and the fact that Maudlin's attempt to reconcile the A-theory with relativistic physics fails due to the issues of simultaneity.

## ***2.1. Taxonomy of A- and B-Theories, Presentism, and Eternalism***

In his 1908 paper, along with arguing for the unreality of time, McTaggart distinguished two ways of thinking about a time series, an A- and a B-series.<sup>30</sup> The

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<sup>30</sup> Note that I am using a slightly different version than the 1908 version. I am using: McTaggart, 1993 [1927]. *The Unreality of Time*. In *The Philosophy of Time*, edited by R. Le Poidevin and M. MacBeath: Oxford University Press. This 1993[1927] version is drawn from chapter 33 of J M E McTaggart's *The Nature of Existence*. Note also that both series have the same events in the same order. It might be said, therefore, that they are not actually different series, but different ways of conceptualising the same series. If a series is defined by the items in it then it follows both series are the same series, however in the case of the A and the B-series, while the items in the series (events or moments of time) are in the same order, they are ordered in virtue of different properties: their A-series or their B-series properties. To illustrate: Suppose we have a collection of blocks and we place them in order from smallest to largest, then once they are in that order we paint them from light to dark, the smaller blocks being painted lighter. We can now order the blocks due to their size, or due to their colour, but both

distinction between the two series and their accompanying theories of time has become the chief way to differentiate two different families, or genera, of views on time. The A-series is a series of time in which the moments of time (and the events at those times) are ordered in virtue of the objective moving or passing NOW, and thus are past, present, or future. The corresponding A-theory holds that the properties of *pastness*, *presentness*, and *futurity*, which are had by events at moments of time, are fundamental to the nature of time. The A-theorists, believe that any view that leaves out these properties,<sup>31</sup> and hence excludes the dynamic or ‘tensed’ aspect of time, is missing out the fundamental features of time.

On the other hand, on the B-series, the events or moments in time are ordered in virtue of the *earlier than*, *later than*, and *simultaneous with* relations in which they stand with other moments in time, rather than utilising the A-theorists’ *past*, *present*, and *future* which orders the events in relation to the objective moving present. A B-theoretic view does not hold a realist position on the *passage* of time, or the moving NOW (Realism being understood as the general view that the existence of the thing in question is not a dependent or subjective existence). B-theorists think of the present or the NOW as being an indexical notion, for example Bigelow (1991, 2) even calls the B-theory the indexical theory. Given they are non-realist about the moving NOW or *passage* of time, the B-theorist may be eliminativist and deny it completely, or acknowledge that it is a feature of human experience, but not that it is a feature of objective reality, and perhaps account for it by appeal to the human brain, or some other method. The B-theorist will still be able to help himself to the A-theorists’ talk of ‘past’, ‘present’ and ‘future’ because he can reduce such talk to the B-theoretic notions of ‘earlier than the indexical now’, ‘simultaneous with the indexical now’, and ‘later than the indexical now’. In sections §2.1.1 to §2.1.3 I will explain my usage of the terms the A- and B-theory since there appears to be no totally standard usage, and I will defend this usage based on an examination of the original usage as in McTaggart. In

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orderings will produce the same series. It is also worth noting here that I will argue in Chapters Three and Five that this has implications for time-travel.

<sup>31</sup> Or some analogue of them, as is the case on Presentism, as discussed in §2.2.

section §2.1.4 I will defend my use and definition of Eternalism based on an examination of early usage, such as in Lovejoy (1909, 1910) and an examination of current modern usages.

Just as we have families of views which are realist or anti realist about the passage of the NOW, we have families of views which hold realism or anti-realism about moments of time on either side of the present (see accompanying table). The realist or non-realist positions on these two notions – passage of time and moments of time – can each be placed on axis of a table representing the two dichotomies. On the axis which represents stances (realism or antirealism) on moments of time we have Eternalism, which holds that all moments of time exist,<sup>32</sup> and is often used as a synonym for the B-theory, but in fact it should not be as there are both A-theoretic and a B-theoretic Eternalist views. Under the Eternalist family, there is the ‘Moving Spotlight’ view, which is A-theoretic in nature because it subscribes to an objective moving NOW, but it is Eternalist because it holds that all moments of time exist. Secondly, we have the ‘Block Universe’ view which is B-theoretic in nature because it denies passage. The Block Universe view has two other names: Firstly, it is sometimes called ‘Four-Dimensionalism’ because it holds that time is a dimension analogous to the spatial dimensions.

However, the title ‘Four Dimensionalism’ is somewhat ambiguous because it is often used to distinguish a Perdurantist position from an Endurantist position on persistence over time.<sup>33</sup> Sider agrees that “[t]his terminology is not perfect: ‘four-dimensionalism’ is also sometimes used for the view in the philosophy of time called ‘Eternalism’, on which past, present and future are equally real” (Sider 2000). Secondly, as mentioned before, the Block Universe view is also often simply called Eternalism, which is also ambiguous, in this case between the A-theoretic and the B-theoretic types of Eternalism. However, since the Block Universe view is the only kind of B-theoretic view, ‘Block

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<sup>32</sup> I will discuss this interpretation of the notion of Eternalism in §2.1.4.

<sup>33</sup> For a thorough discussion of this, see Sider (2001), and for unusual pairings of the views see Daniels (2013 manuscript) and Baron and Monton (2013 manuscript).

Universe’ or ‘B-theory’ can be used interchangeably as a non-ambiguous term, to refer to the only B-theoretic view on our table of classification.

Figure 5: Table for Classification of Philosophical Positions on Time

	<b>A-theoretic</b> (realist about passage)	<b>B-theoretic</b> (non-realist about passage)
<b>Eternalist / Realist about all moments of time</b> <sup>34</sup>	<i>Moving Spotlight</i>	<i>Four-Dimensionalism / Block Universe / B-Theory</i>
<b>Realist about the Past and Present, Possibilist about the future</b> <sup>35</sup>	<i>Branching Tree</i>	~
<b>Realist about the Past and Present, non-Realist about the future</b>	<i>Growing Block</i>	~
<b>Non-Realist about past and future, Realist about present</b>	<i>Presentism(s)</i> <sup>36</sup>	~ <sup>37</sup>

In contrast to the Eternalist family of views that are realist about past and future

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<sup>34</sup> I follow Parsons (2005) and Dummett (1969) in holding that “the reality of the past (and, by analogy, the reality of the future) is an issue of realism versus antirealism” about moments of time (Parsons 2005, 161).

<sup>35</sup> Note that Possibilism is a form of anti-realism (anti-realism classically understood) and hence the Branching Tree view could be understood as a form of Growing Block universe.

<sup>36</sup> Here I take Presentism to be a group of views, not a singular view. Such a group might also include possible-worlds-presentism and ersatz-presentism.

<sup>37</sup> Imagine what we might call a static Presentist view, a view that holds anti-realism about moments other than the present (Presentism), while also holding anti-realism about passage (B-theory). It might be said that this is the view which McTaggart believes is a correct description of reality and is therefore the reason he holds that there is no time, since such a view is not a view of time, but a view which entails there is *no* time.

moments, there are the anti-realist views of past and/or future moments of time.<sup>38</sup> But, unlike the Eternalist family that contains Four-Dimensionalism (the B-theory), and the Moving Spotlight view, under *this* family there is only one view, namely the ‘Presentist’ view of time, which is also an A-theoretic view of time. It holds that present moments, events, objects, and states of affairs are all that exist, and it is anti-realist about other moments of time (and their corresponding events, objects and states of affairs). By this I mean that if the Presentist holds that past and/or future moments exist, they do so only as memories, possibilities, hopes, predictions, retro-dictions, and so on. Whilst Presentism is anti-realist about moments other than the present, holding that those moments do not have (independent) existence, it is realist about the *passage* of time, or the objective moving NOW, it is a dynamic or tensed view and hence it is an A-theoretic view under my classification system. But while, according to Presentism, there is only one moment of time that exists – the present – which moment that is, i.e., which moment is the present moment, will change as time passes and new moments of time come into existence, while earlier moments go out of existence. To my knowledge there is no B-theoretic (static / tenseless) view which holds anti-realism about the moments of time<sup>39</sup> (a strange view it would be – denying the passage of time, and denying the existence of moments of time).

There are also three intermediate A-theoretic or tensed views which sit between the Eternalist and Presentist views – the Growing Block, the Branching Tree, and the Moving Spotlight views. The *Growing Block* view holds realism about the past yet anti-realism about the future. It should be noted that the *Growing Block* Universe is a distinct position from the Block Universe *simpliciter*, which we will now call simply the B-Theory. The *Growing Block* view, unlike the Block Universe *simpliciter*, holds that the future is ‘genuinely open’ and as yet, simply does not exist. It is an A-theoretic view, and it maintains that the moving NOW is what creates, or brings into existence, as it

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<sup>38</sup> I am assuming that there is no view, which holds anti-realism about the present (as well as the past and the future).

<sup>39</sup> At least not in contemporary Analytic philosophy. See figure 5.

were, the moments of time. As it moves it realises and actualises the moments of time in the future by making them present and then past.

The Branching Tree view could perhaps be seen as a sub-view of the Growing Block view, because both subscribe to a type of non-realism about future moments of time.<sup>40</sup> One holds a Branching Tree view if one holds that the past is fixed (like the growing view) but *unlike* the Growing Block view, holds also that the future is a myriad of possibilities. On the Branching Tree view, future possibilities are able to be represented by the branches on a tree, and these branches could be said to fall from the tree as the objective NOW moves upwards, actualising certain branches or possibilities, and discarding others (McCall 1994) or rendering them non-actual (Dempsey 2014; Martinez 2011). How Eternalist the Branching Tree view really is will depend on what view we take on possibilia, since the future branches exist as possibilities.

Alternatively, if one holds realism about the future and takes it to be somehow fixed or determined, even though it is not yet actualised, it may be more similar to a Moving Spotlight view, in which all moments of time do exist yet they are not present unless the NOW (represented by the spotlight) is on them. This view is like the B-Theoretic / Eternalist / Four-Dimensionalist view of time, except with the added ontological feature of an objective moving NOW, represented by a spotlight which moves across the moments in time, illuminating those in the present.

It should be noted that rather than representing these views on a table, these views on time could also be placed on an axis (see accompanying), similar to the spectrum representation of political positions.<sup>41</sup> This would require one axis to represent realism

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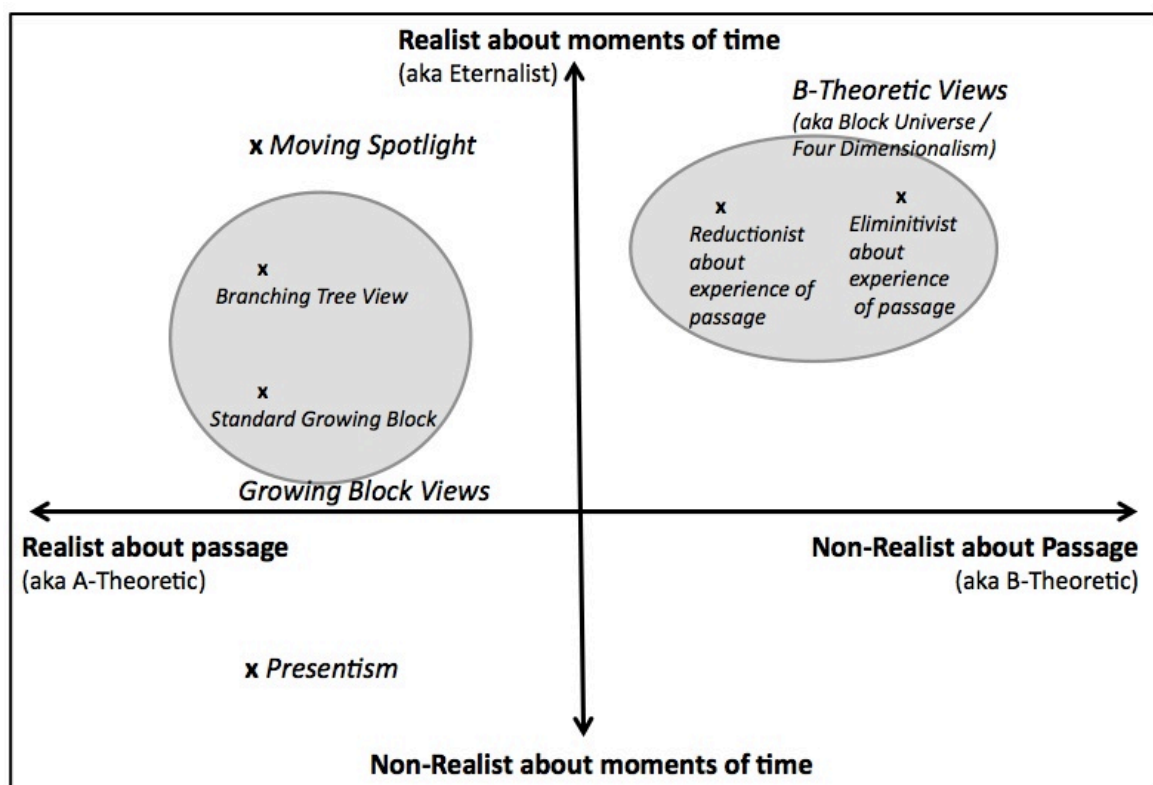
<sup>40</sup> Miller might be said to hold this view. She claims that a Storrs McCall (1994) type Branching Tree view “is consistent with and, indeed, entails the intuitive view” (2008, 175), the ‘intuitive view’ being understood as a view which holds the past fixed and the future open (2008, 174). However, she does not want the intuitive view to be understood necessarily as a Growing Block view, because the features of her intuitive view are causally indeterministic, whereas the Growing Block view may or may not be causally indeterministic.

<sup>41</sup> See, for example, <http://www.politicalcompass.org>



and non-realism about the passage of time, while the other axis represents realism and non-realism about the moments in time (specifically past and future moments). The accompanying diagram or axis is analogous to the accompanying table of philosophical positions, with regards to the (approximate) placement of the philosophical positions on time.

Figure 6: Axis/Spectrum for Classification of philosophical positions on time



Though the distinctions in the diagram can be found in the literature, a novel feature of this section arises from my new way to represent explicitly how we classify or organise our views on time. My explication of the views highlights the need to classify the views based on *two dichotomies* and not one: Those two dichotomies being, firstly, realism and anti-realism about the passage of time (of the NOW), and secondly, realism or anti-realism about the existence of moments in time. Others (such as Price, Muis, and Williamson) have recognised that there is more than one dichotomy, but no one has represented the dichotomies in such a way. Price (2009) holds that there are three dichotomies, the additional one being the question of realism and anti-realism about

the direction of time, while Muis (2005) would assert that an additional dichotomy was the Endurantism–Perdurantism debate on persistence over time. In *Modal Logic as Metaphysics* (2013) Williamson argues that the Presentism–Eternalism debate is “hopelessly muddled” and that we should instead get on with the “Permanentism–Temporaryism” (A- and B-Theory) debate,<sup>42</sup> suggesting that he also recognises the two dichotomies, but finds the A- and B-theory debate to be more pertinent. Given that the talk in philosophy of time often merges certain views, such as Eternalism and the B-theory, it would seem that such talk sometimes intends, or at least implies, that there is only one dichotomy in dispute, and sometimes suggests that one dichotomy always implies a certain position on the other dichotomy. The main point to be taken from this section is that we are explicit that there are two dichotomies and not one.

I allow that the reader may disagree with the way that I have classified and defined the views or terms – for example, the reader may hold that Eternalism should correctly be understood not as a realism about all moments in time, but instead as a static view without passage (which is what I have termed the B-theory). This is *not* the main issue. I am happy for someone to arrive at a different conclusion elsewhere on what some view in philosophy of time *should* be *called*, or how certain notions like Eternalism are to be understood. Since there is no standard usage across the board, I have stated how I will be utilising the terms in *this* dissertation, and how they should be understood *here*.

What is the main issue, what is the important point to take away from this section, is that (i) utilising two dichotomies rather than one helps to better frame the disagreements that are happening in philosophy of time. And that (ii) the *descriptions* attached to the terms (and not necessarily the terms themselves) belong where I have placed them on my axis and table. I am not merely making a descriptive claim about how I am using the terms. I am also, and more importantly, making a claim about how

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<sup>42</sup> “Although we might complicate the definitions of ‘Presentism’ and ‘Eternalism’ in attempts to construct a more sensible dispute, it is better to make a fresh start with fresh terminology and clearer distinctions. Thus the proposal is to abandon that debate as hopelessly muddled, and to get on with the clearer permanentism–temporaryism debate...” (Williamson 2013, 25).

we should be classifying the views, as this aids clarity in philosophical discussions. However, in case it should matter, I will now go on to offer a brief defence my use of the terms ‘A-series’, ‘B-series’, and ‘Eternalism’, by consideration of McTaggart (1993 [1927]) and Lovejoy (1909, 1910), amongst others.

### **2.1.1. Use of the Terms ‘B-Series’ and ‘B-theory’**

In what McTaggart terms the B-series, we do not attribute pastness, presentness or futurity to the events in the time series, we merely think of events as temporally ordered, with before, after, and simultaneous relations. These two place relations or ‘B relations’ – such as *two days after*, *one day before* or *simultaneous with* – fix the event’s position in the time series. On the B-series, each position “is earlier than some and later than some of the other positions” (1993 [1927], 24), McTaggart also claims that the relations ‘earlier than’ and ‘later than’ are transitive and asymmetrical. Being asymmetric means that for any event M, if M is earlier than N, then N is later than M. Being transitive means that if an event O is later than N, and N is later than M then O is also later than M. It should also be noted that an event’s position in the B-series does not change. It will always be the case that the 4<sup>th</sup> of February 2012 is two days before the 6<sup>th</sup> February 2012, and that the 6<sup>th</sup> of February 2012 is two days after the 4<sup>th</sup> February 2012, likewise for any events that happen on those days, such as birthdays. So if Mark’s birthday is two days *earlier than*, or *before* Nora’s birthday, then Mark’s birthday will be two days before Nora’s birthday when Mark’s birthday is in a million years earlier than now, or a thousand years later than now. On the B-series, the times and the events at those times will never change their B-series characteristics or positions. McTaggart also presents the argument that there can be no change on the B-series, since events have fixed positions on the B-series and facts about those events and their positions do not change. Thus McTaggart concluded that the A-series was needed for an account of time, but also concluded that the A-series was inherently contradictory. The contradiction is known as McTaggart’s paradox and I will return to it in §2.2.

Here we should take a short digression to discuss change on the B-series. McTaggart claimed that there was no change on the B-series, and so he held that the B-series is not sufficient for time, since time necessarily involves change. The B-theorist, who holds that the B-series is sufficient for time, argues that change is not an event being future, becoming present, and then past, but rather that change should be understood as something having different properties over time. Most A-theorists also accept this supposedly B-theoretic notion of change – it is after all the common sense notion of change. The A- and the B-theorists do not disagree on what constitutes change, and whether there is change on a B-series. Rather, they present McTaggart’s concern in a slightly different way: Time necessarily involves passage, i.e., the movement of the NOW, and there is no *passage* on the B-series.

### 2.1.2. Use of the Terms ‘A-Series’ and ‘A-theory’

Events in the A-series are ordered by different properties than those of the B-series; namely the properties of being past, present or future. I shall follow McTaggart in calling these properties: *pastness*, *presentness*, and *futurity*. It should be noted that while the B-series positions are permanent, the A-series positions are not, “an event which is now present, was future, and will be past” (1993 [1927], 24), “no fact about anything can change, unless it is a fact about its place in the A-series” (1993 [1927], 28). The A-theoretic view is not just the view that moments in time have the properties of pastness, presentness, and futurity, but it is also characterised by the notion of flux or movement. No A-theoretic view holds that times (or moments in time) are past, present or future without also holding that those moments change from, for example, future to present, or present to past.

While the notions of objective present and objective passage are often joined as one under the concept of the A-theory, Huw Price (2009) points out that the notions of objective present, and objective flux are really two distinct concepts. He also highlights the fact that a third distinct concept, that of objective direction is also lumped in there. Although, arguably, objective direction is not necessarily a feature restricted to the A-theory. In Chapter Four I will discuss what the notion of direction could be on a B-

theoretic picture. But, I want to leave the notion of objective direction for the moment and focus on the defining feature(s) of the A-theory: the notion(s) of an *objective* and *moving* present or ‘now’. This is the idea that, either there is such a thing as the ‘now’ that moves along the dimension of time (the Moving Spotlight view), or the ‘now’ which bring moments of time into existence (the Growing Block view), or which brings the moments both in *and* out of existence (Presentism). Without the A-series McTaggart (1993 [1927]) claims there would be no change because the B-series properties do not change. McTaggart claims, “there is only one class of characteristics [that can change]. And that consists of the determinations of the event in question by the terms of the A-series” (1993 [1927], 26). It should also be noted here that McTaggart has an unusual conception of change. Change is normally thought of as a thing having incompatible properties at different times. On McTaggart’s account of A-series change, however, change involves transitioning from future, to present, to past.

It should also be noted that some Presentists will not be happy with their position being understood as a type of A-theory.<sup>43</sup> This is because McTaggart’s exposition of the A-series implies that moments other than the present exist. McTaggart’s A-series is rather similar to a Moving Spotlight view in which all the moments in time exist and the objective moving NOW passes along them. The Presentist will hold that his view is dramatically different from McTaggart’s A-series because he is anti-realist about moments other than the present. However, given the way I have classified the views, the Presentist is an A-theorist, because they are realist about the moving NOW. Their stance on the existence of moments of time other than the present moment concerns a separate dichotomy. In the end, this is not a substantial disagreement. It does not amount to any different understanding of the Presentist view, only a difference in the way terms, like A-theory, are used.

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<sup>43</sup> John Bigelow holds this position. (Personal communication, February 2013)

### 2.1.3. Further Examination of McTaggart

I would now like to address some questions which may have arisen from the explication of the A- and B-series. Firstly, are Pastness, Presentness and Futurity properties or relations (relational properties)? Until now I have referred to them as properties, but McTaggart states “it seems quite clear to me that they are not qualities [properties] but relations, though of course, like other relations, they will generate relational qualities in each of their terms” (McTaggart 1993 [1927], 31). McTaggart reminds us nevertheless; that even were they qualities and not relations the A-series would still face McTaggart’s Paradox – which I will address shortly in §2.2. McTaggart does not discuss any further whether *pastness*, *presentness* and *futurity* are relations, so let us consider this further in what follows.

If pastness, presentness and futurity are relations, what then is the thing or *relatum* to which the moments in time are related to in order that they possess these A-series relations? Since the moments of time in the A-series change which A-series property they possess (*pastness*, *presentness*, or *futurity*), McTaggart claims that these moments must be in relation to “something outside the time series [because] no relations which are exclusively between members of the time-series can ever change” (1993 [1927], 31). To understand what McTaggart means, let us first rule out the possibility of the A-series properties being relations *within* the time series. To illustrate: take two members of a time series, two times, March 12<sup>th</sup> 1902, and March 14<sup>th</sup> 1902. It will always be true that the 12<sup>th</sup> is two days earlier than the 14<sup>th</sup>, whether we are considering the relation of those two dates from the viewpoint of 200BC, 1902 itself, or the big crunch at the end of the universe. Likewise with events-at-times, the relation between Mark’s 5<sup>th</sup> birthday and Mark’s 6<sup>th</sup> birthday will always be the same relation. In fact, considering the relations between moments or events within the time series reduces us to a B-series, because the B-series relations do not change, and the B-series relations are relations between times and events within the B-series.

“We must say that a series is an A-series when each of its terms [relata such as times, or events-at-times] has, to an entity X outside the series, one and only one, of three indefinable relations, *pastness*, *presentness*, and *futurity*...” (McTaggart 1993 [1927], 32).

So we can conclude, that

*“This term [the relatum], then, could not itself be in time, and yet must be such that different relations to it determine the other terms [other relata] of those relations, as being past, present or future”* (McTaggart 1993 [1927]).

Therefore, McTaggart’s answer is that the relatum to which the A-series times or events-at-times are related to, must be something outside the time series itself. This is because the relatum cannot be within the time series because then it would be another time or event-at-a-time, and as I have just shown, the relational properties of the A-series would be lost or reduced away and we would be left with B-series properties (static relational properties between times, or between events-at-times). It should be noted however, that it is not entirely clear how things within time (or more specifically times and events-at-times within the time series) can stand in a relation to something outside of time (outside of the time series). The closest contender for the relatum or the ‘X’ McTaggart talks of, would be the objective moving NOW. So, let us understand that the A-series times and events-at-times have their A-series relations in virtue of their relationship to the objective moving NOW. A time being *past* means that that time (or moment of time) stands in a certain relation to ‘the NOW’, namely it was simultaneous with ‘the NOW’, and now no longer simultaneous with ‘the NOW’. While if a time is present it is currently standing in the simultaneous relation with the objective moving NOW. Thus we can see how McTaggart understands the A-series properties to be relational properties which are generated, lost, and gained in virtue of the passage of the objective NOW.

Another question that we might now ask is that of whether the A-series implies or contains the relations of the B-series. It might be thought that since the B-series is essentially a linear ordering of times and events-at-times, thus giving a basic structure to time, that the A-series must contain within it a B-series, or, also contain the B-series relations. I think this intuition that we might have, serves to show, not that the A-series contains within it a B-series, but that the B-series – understood as basic ordering of time – is essential to time because we cannot make sense of time without times/moments, and events-at-times, standing in B-series relations to each other. McTaggart too claims

that both the A- and the B-series are essential to the reality of time, “we never *observe* events in time except as forming both these series” (1993 [1927], 25).

So, can the A-series and its relations also generate a basic ordering and structure to time? Do the A-series relations give us enough information to order its contents (times and events-at-times) into, not just three groups, past, present and future, but also for them to have a linear order? I think McTaggart intends the answer to be yes. He claims the A-series to be “that series of positions which runs from the far past through the near past to the present, and then from the present through the near future to the far future, or conversely”<sup>44</sup> (1993 [1927], 24). If it is the case that there are not merely three A-series properties – pastness, presentness and futurity – but that those three A-series properties represent three general groups, then we may be able to place all A-series times and events-at-times into a linear order rather than simply into three groups. Consider that within those three general groups (times with pastness, presentness, or futurity), there are more complex properties such as the ones McTaggart mentions: *far past*, *near past*, *near future*, *far future*, as well as others that he does not mention, such as: 5 minutes 40 seconds past, 3 minutes 22 seconds past, 3567 years and 22 seconds future, then we can understand all the events on the A-series as being in a linear order in virtue of their more complex A-series properties – and the B-series properties, which are earlier, later, between, and simultaneous with, are not needed to order the A-series. Thus the A-series does not also contain a B-series as such, but it does contain a basic ordering which can be derived from the A-properties.

#### **2.1.4. Use of the Term ‘Eternalism’**

Here I want to give a short literature review of the usage of the term ‘Eternalism’ over the last century or so. This is partly to justify the way I am using the term, but also to illustrate the need for two dichotomies.

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<sup>44</sup> The “or conversely” implies that McTaggart is leaving open, for now, the question about which of the two directions on the time dimension (past to future or future to past), is *the* direction. I will look into this further in Chapter 4.



The earliest usage of the term 'Eternalism' in philosophical literature appears to be by Lovejoy where it is understood as "timeless existence" (Lovejoy 1909, 482), as opposed to 'Evolution', the view which incorporates temporal becoming or what we usually now call dynamism. In Lovejoy's following paper he states that "what I have called temporalism is obviously the antithesis of 'Eternalism'" (Lovejoy 1910, 684). Here we might think that he is using the terms Eternalism and Temporalism (or Evolution) the same way that I use the terms of the A- and the B-series: namely, as demarcated from each other by their positions on passage or dynamism. However, he also talks of a Professor Royce who defends a view where "the Eternalism of that doctrine is united with a species of concrete temporalism" (Lovejoy 1910, 686), which would suggest that Lovejoy does not take the notions of Temporalism and Eternalism to be defined in such a way that they are mutually exclusive. One way that this would be possible is if he interprets each view (Eternalism and Temporalism) as holding a position on *two* issues or questions rather than one (the question of passage and the question of existence of moments), in which case one could hold a hybrid Eternalist-Temporalist view by taking one position on the first issue, and the other position on the second issue. This means that as early as 1910 when the view first emerged, they were already making the mistake that I have claimed contemporary philosophers of time make since they often fail to recognise that there are two distinct questions of realism or anti realism; each giving rise to a dichotomy, meaning there are two dichotomies not one.

We also see a trend of the term Eternalism becoming used as a position on the state of truth values - "the mere truth of any proposition as somehow subsisting in a realm where all questions of date are irrelevant" (Lovejoy 1910, 687) - and less on the two main dichotomies that I identify. We see this interpretation being used from 1981 (Richard 1981), through 1996 - "Temporalism is the view that at least some propositions vary in truth value over time. Eternalism is the opposite doctrine" (Aronszajn 1996, 71) - until as recently as Brogaard (2012).

There is another interpretation of 'Eternalism', namely, how I have defined it in this chapter: a view which is realist about moments other than the present. This

interpretation, as well as the interpretation focused on truth values, seem to be the two ways that the term Eternalism is used in present times, and not a question about realism or antirealism of objective passage, as suggested by Lovejoy's (1909) talk of 'Evolution' or dynamism in his early paper. To illustrate this use, consider the following passage in or references to these works: Hartshorne claimed that Eternalism is the view that "Everything whatever is to be viewed 'from the standpoint of eternity'." (1956, 657); Hinchliff maintains that on Eternalism "time is like space... there is nothing special about the present; things at other times are just as real; no time is metaphysically distinguished" (Hinchliff 1996, 122); Sider claims that "the view in the philosophy of time called 'Eternalism', [is that] on which past, present and future are equally real" (Sider 2000); Likewise Callender asserts that "the traditional tenseless view of time known as *Eternalism* states that all the lights on our four-manifold are on – that is, they all exist" (Callender 2000, S587); Remko Muis<sup>45</sup> also holds this interpretation, as seen by his claim that "*Presentists* believe that only present things exist, whereas *eternalists* think that also past and future things exist, even though they do not exist now" (Muis 2005).

With all this being said, one may still come to a different conclusion on how the notion of Eternalism should be understood. Nevertheless, what I am showing here is how I will be using this term in the remainder of this dissertation, and providing a small literature review to justify my interpretation, and also to support my prescriptive claim that we should employ (at least) two dichotomies, and not one.

#### **2.1.5. Hybrid A-B Theories**

It is worth noting that on my classification of views on time there can be no such thing as a hybrid A-B theory. Many philosophers, such as Craig (2001, 33) and Oaklander (1999, 317), often use the term 'hybrid A-B theory' to refer to a theory of time which is both Eternalist and A-theoretic. By that I mean a view which is realist about the passage

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<sup>45</sup> It is worth noting that Muis recognises the two dichotomies that I focus on, as well as a third – those of Endurantism versus Perdurantism on the topic of persistence over time.

of time (or the changing of properties of pastness, presentness and futurity) as well as realist about all (or most) of the moments in time – such as a ‘Moving Spotlight’ view, which is realist about past, present and future. The key tenets of a Moving Spotlight view are not incompatible, but the hybrid A-B theories are not possible on my view because of how I have defined the A- and the B-theories. At this point we should ask whether, therefore, my classification of views on time really follows from the defining features of those views, and whether my classification is reasonable. Are the A- and the B-theories mutually exclusive? The way that I have defined them they are. This is because I have defined the B-series as non-realist about the passage of time, whereas the A-theorist is realist about the passage of time. However McTaggart claimed that we “never observe events in time except as forming both these series” (McTaggart 1993 [1927], 25), which implies that time, or our perception of time at least, is of a hybrid A-B-series sort. Note that while it may be the case that the A- and the B-series are compatible, the A- and the B-theories are not. The series are simply different ways of ordering the same events (and in fact they put the events in the same order, so in some sense they are the *same* series!), but the *theories* are not compatible because they disagree about what is ordering the moments in time, and one view – the A-theory – holds that the ordering feature is the objective moving NOW, whereas the other view – the B-theory – denies the existence of that ordering feature. Hence the *theories* are not compatible.

However, I believe this to be mistaken. The reason that McTaggart thought that time necessarily involved both was because he thought that time must have a basic ordering (B-theory) as well as the objective moving NOW (A-theory). Yet as I explained in the section above an A-series can also generate a basic ordering or linear structure to time if we suppose that there are more complex A-series properties such as *far past*, *near past*, *near future*, *far future*, which McTaggart himself mentioned, not just the three properties, *pastness*, *presentness* and *futurity*.

Normally the B-theory is defined as being both Eternalist (or realist about all moments in time), and as also denying the objective moving NOW, or temporal passage. However, I do not want to allow ‘Eternalism’ to be a pseudonym for the B-theory, as it is often

used, because there are A-theoretic Eternalist views too, such as the Moving Spotlight view. All B-theoretic views are Eternalist views, but not all Eternalist views are B-theoretic. If we have defined the B-theory as that which rejects the notion of passage, as most philosophers do, then it does not make sense to say that there can be hybrid A-B views. This is because a view cannot be both realist about the passage of time whilst also denying the passage of time, since these are mutually exclusive. Thus, if we do not use Eternalism as a pseudonym for the B-theory, we can instead call these so-called ‘hybrid A-B theories’ ‘Eternalist A-theories’, and the ambiguity is removed. Should this cause any confusion between my nomenclature and other philosophers’, I will point out when a view is a hybrid A-B theory on another’s classification yet an Eternalist A-theory on mine.

In his paper “The A-Theory of Time, The B-Theory of Time, and ‘Taking Tense Seriously’” (2005) Zimmerman does some work on distinguishing the A- and the B-theories in light of the fact that there are A-theoretic, Eternalist theories, and that there are, he believes, B-theories which ‘take tense seriously’, a feature usually thought to be A-theoretic. Zimmerman does not conclude, as I have, that the defining feature of the A-theory is its adherence to the notion of an objective, non-indexical NOW. Instead he concludes that “the essence of the A-theory is the objectivity of the distinction between past, present and future. What is presently true is true, *simpliciter*, not merely true relative to a time, utterance or situation” (2005, 431. Emphasis Original), and that the “A-theorist’s best bet [with regards to distinguishing herself] seemed to be to affirm something no self respecting B-theorist should accept: A non-relativised kind of truth that applies to propositions that are only temporarily true” (2005, 453). However, I see no reason why Zimmerman’s conclusion as to the distinction between the A- and B-theories need conflict with mine. And he certainly concludes, as do I, that the ‘Eternalist’ label should not be used as a pseudonym for the B-theory.

## ***2.2. Incompatible Temporal Relations and the Infinite Regress***

Now that we understand what the A-theory is, I want to consider why we should reject it as a viable metaphysical doctrine. I will presently explain why the changing A-series

properties (that the A-theorist subscribes to) necessarily lead to a contradiction, and how any attempt to avoid this contradiction will lead to an infinite regress of explanation. This is often called McTaggart's Paradox.

McTaggart has claimed that the A-series is necessary for there to be change in time, because what it is that changes is the temporal relations (pastness, presentness and futurity) which an event or moment in time bears. But after arguing this, McTaggart then claimed that the temporal relations are mutually incompatible. An event (or time) that is present cannot be past or future. To put it another way: some event cannot be past, present, and future as these relations rule each other out. "Every event must be one or the other, but no event can be more than one" (1993 [1927], 32). However, each event in the A-series must have each temporal relation in order that it exhibits change: the event changes from future, to present, to past, and this is where we find change in the A-series. The A-theorist subscribes to the view that these A-properties are a necessary feature of an account of time, despite not necessarily holding to the view that the changing A-properties are what constitute change (see §2.1.1 for a brief explanation of A- and B- change).

But McTaggart presents an obvious response to the objection to his claim, namely that it is never the case that the event will have all three temporal relations *at the same time*, instead an event "is present, *will be* past, and *has been* future" (1993 [1927], 32). The temporal relations are not incompatible when they are attributed to the events at different times, rather than simultaneously. It cannot be the case that the weather is raining and not raining, nor can it be the case that an object is red all over and green all over. Yet if at  $t_1$  the weather is raining and if at  $t_2$  the weather is not raining, and if at  $t_1$  the object is red all over and if at  $t_2$  the object is green all over then there is no conflict between the properties. There is no conflict between incompatible properties or relations if they are attributed at different times.

Yet McTaggart believes that this solution is problematic. To say that an event "is present, will be past, and has been future" means only that the event "is present at a moment of present time, past at some moment of future time, and future at some

moment of past time” (1993 [1927], 33). This has not solved the problem because when we say “the event is past when it is future” (or “the event is past at some moment of future time”) we are again attributing multiple temporal relations to the same event – in this example, the temporal relation of pastness and the temporal relation of futurity. When we claim that the temporal properties are attributed to events at different times, we are saying that we are attributing different times to events at different times. We are using the temporal relations to explain the temporal relations. To put this another way, “the nature of the terms involves a contradiction, and [...] the attempt to remove the contradiction involves the employment of the terms, and the generation of a similar contradiction” (McTaggart 1993 [1927], 33, footnote).

This leads to an infinite regress because each time we use a temporal relation (past, present, future) in order to explain a temporal relation (so that it does not lead to a contradiction) we must in turn explain when it is that the temporal relation is used by employing other temporal relations. An event is future, at some time in the past. But when was that time the past? At some time in the future. But when was that the future? And so on. Every time we explain a temporal relation in order to avoid the contradiction, the temporal relation that we use to explain it needs explaining itself. The second order explanations or temporal relations also require an explanation, leading to a third level of temporal relations which explains the second, but then needs explaining itself. And so on *ad infinitum*.

Thus it seems that McTaggart was correct to claim that the A-series leads to a contradiction, and that we cannot avoid this contradiction by explaining the different times that temporal properties hold. This is because it leads to an infinite regress of explanations at each level. The A-series is defined by the events in it which pass from past to present to future, yet if this notion is contradictory, then the A-series is contradictory, and we must do away with the A-series. The only options available to the A-theorist are to accept a contradiction, or accept an infinite regress in order to avoid the contradiction. Since we cannot accept a contradiction or an infinite regress, we must conclude via *modus tollens*, that the A-series is not the correct conception of time.

### 2.2.1. Presentism as a Response to the Infinite Regress

Since I want to show that the A-theory is not a feasible view of time, I will now show why Presentism's attempt to avoid McTaggart's paradox is not successful, and that Presentism should *not* be adopted as an A-theoretic view that avoids McTaggart's paradox, because in fact it does not.

In "McTaggart and the Truth about Time" (2002) Dyke claims that one way in which the A-theorist might avoid the paradox in the notion of the A-series is to assert Presentism and claim that "the present state of affairs is all there is" (2002, 144). (The paradox which the A-series gives rise to is due to the incompatible notions of past, present, and future. The Presentists' rejection of pastness and futurity avoids the regress because the presentists are claiming that an event is present when it is highlighted by the objective NOW. The presentists do not need to explain what it means for an event to be past or future, because *no* events are past or future according to the Presentist, events are only present (assuming that non-existent entities, including events and time, cannot have properties). Presentists claim therefore that their view does not employ these incompatible properties, nor require the temporal relations to be explained, and thus it avoids the regress.

Before we begin it should be noted that there are a number of ways to define Presentism.

- (1) Only present *times* exist (Dowden 2011), (Miller 2005b, 223) (Crisp 2003, 221) (Mellor 1998, 56) (Garrett 2006, 81) (Noonan 2013) (Prior 1967, 1968).
- (2) Only present *objects/things* exist (Markosian 2013; 2009, 127) (Monton 2003, 199) (Sider 2005, 329) (Crisp 2003, 221) (Rea 2003, 246) (Noonan 2013).
- (3) Only present *events* exist (Monton 2003, 199).
- (4) Only present *states of affairs* exist (Dyke 2002, 144).
- (5) Only present *facts* exist (Le Poidevin 2003, 136).

- (6) Presentism understood as a type of tensing (Prior 1967, 1968).<sup>46</sup>
- (7) To be present is to be actual (Bigelow 1991) (Craig 1998, 1999) (Schlesinger 1994).
- (8) To be present is to be true (Crisp 2010).

I will take the notion that “only what is present is real” (Le Poidevin 2005, 159) to be a combination of definitions 1 to 5 because I believe they are all expressing the same idea in slightly different ways, for example, some philosophers, such as Noonan (2013) think that (1) and (2) are equivalent. Perhaps (1) and (2) are not equivalent because (1) seems to hold for empty time whereas (2) excludes empty time. But I do not intend to discuss these subtleties and I do not think that they will make any difference to the conclusion I draw.

An interesting, but somewhat tangential, consequence arises from the Presentists’ denial of past and future. If past and future times, events and things are non-existent and consequently do not have properties (including the properties of being past and future), then it would seem that there can be no truth to the claim that last Monday I was at the beach, or that Edward was my grandfather. Or, if there is such a truth, it cannot be based on real relations and properties between the present and the objects and events at those other times, it must instead be somehow based on what is currently in existence – Bigelow (1996) gives an analysis of how this is done. So the Presentist is faced with a dilemma: deny that the past and future exist and be forced to also deny truths about the past and the future, or, allow the existence of past and future and lose the defining features of Presentism and fall prey to McTaggart’s Paradox. Some attempts have been made to explain how Presentism can “have its cake and eat it too” with regards to denying the existence of past and future moments of time, but still giving an account of cross temporal relations and past truths.<sup>47</sup> I will not discuss these

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<sup>46</sup> “Prior (1968, 18) holds that “is present”, “is past”, etc. are only quasi-predicates,’ which do not designate properties (‘like temperatures’), and which are to be analysed by means of sentential operators like ‘it was that case that’.” (Percival 2002, 95).

<sup>47</sup> For a discussion of these see Bigelow (1996), who calls this objection the “argument from relations”.



attempts because, regardless of their success or failure, I believe that Presentism fails for another reason: it does not avoid McTaggart's paradox after all, and this is what I will argue here.

The problem is that Presentism's denial of the past and the future and hence its lack of McTaggart style incompatible temporal properties, involves a denial of the precise features which create the A-series change. In their attempt to save the A-theory from the infinite regress, the Presentist, has lost the A-series' change. A-series change is the notion that change happens when an event moves from future to present to past. Not all A-theorists are committed to this notion of change, in fact most are not (see §2.1.1), but whether it be considered the definition of change or not, all A-theorists are committed to the notion that an event's movement from future to present to past is a fundamental feature of time – because this notion of an objective moving NOW is the defining feature of an A-theoretic view.

In McTaggart and the Truth about Time, Dyke claims

*"The Presentist's response to McTaggart effectively involves denying that A-series change takes place. Certainly the Presentist can talk about events that will be present, and eventually that will, in a week's time, be two weeks past, and this way of talking gives the impression that A-series change is consistent with the Presentist picture. But all these expressions really convey is that every event is located somewhere in the A-series, and that, were a different moment present, they would be located elsewhere in the A-series. Presentism, it seems to me, cannot accommodate the change in A-series positions that times and events undergo, for as soon as it attempts to do so, it falls right back into McTaggart's paradox"* (Dyke 2002, 144).

The Presentist denies that there exist past and future times, events, and things. So, assuming the common philosophical position that non-existent things do not have properties the Presentist has to agree that the past and future times do not have properties. This means that those times also do not have the properties of being in the future and becoming present and then becoming past. However, McTaggart has claimed that every event must have them all in order to have A-series change; that change being the passage of time. This is Dyke's point: that the Presentists' response to

McTaggart “effectively involves denying that A-series change takes place”, which means that although it avoids McTaggart’s Paradox it does away with A-theoretic passage – with the notion of times changing their A-series properties.<sup>48</sup>

On Presentism, the objective NOW is not moving along a timeline – as it does in the Growing Block, the Moving Spotlight, or the Branching Tree view. Instead, things, events, and times are coming into and then going out of existence. But as Prior notes, “getting more and more past seems to be something an event does when it doesn’t exist and this seems very queer indeed” (Prior 1993 [1968], 37). So how can Presentism deny the incompatible properties so that it avoids McTaggart’s paradox, yet somehow still adopt them into its ontology to the extent that it allows for A-theoretic passage? Answering this question leads us to the “problem of temporary intrinsics”.

### ***2.2.2. The Problem of Temporary Intrinsics***

In the literature, one of the most obvious attempts to address whether Presentism avoids McTaggart’s Paradox takes place in a discussion between Craig and Oaklander on Temporary Intrinsics. While the problem of temporary intrinsics is to do with how an object can have intrinsic (non-relational) properties that are temporary, and thus it ties in with problems to do with ordinary change, I will here attempt only to focus on how this problem ties in with McTaggart’s Paradox, and whether Presentism is a solution to this paradox.

In his paper “McTaggart’s Paradox and the problem of temporary intrinsics” William Lane Craig argues that “McTaggart’s Paradox is actually a special case of what Lewis (1986) has called the Problem of Temporary Intrinsics” (Craig 1998, 122). Merricks formulates this problem as follows:

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<sup>48</sup> I will address the issues surrounding A-theoretic and B-theoretic change elsewhere. It may be said that this does not constitute change. Regardless of whether or not this is change, the A-theorist is committed to the notion that an event’s movement from future to present to past is a fundamental feature of time – because this notion of an objective moving now is the defining feature of an A-theoretic view.

- “(1) O at t is identical with O at t\*"*
- (2) O at t is bent*
- (3) O at t\* is not bent*
- (4) If O at t is identical with O at t\*, then O at t is F iff O at t\* is F.*
- (5) Therefore, O at t is bent and not bent.”*

(Merricks 1994; as cited in Craig 1998, 122).

The problem is that an object, O, must necessarily be identical to itself, but it cannot be self-identical at two different times, *t* and *t\** if it has different intrinsic properties, *F* (e.g. bent), at those different times.<sup>49</sup> The same can be said of events in McTaggart’s A-series. If the death of Queen Anne (or DQA) has at one time the property of being present (analogous to Merricks’ 2), and at another time the property of being past (analogous to Merricks’ 3), then it is not the same event (analogous to Merricks’ 4). So this is the problem of temporary intrinsics or of temporary A-series properties. Here is McTaggart’s argument formulated as the argument for temporary intrinsics, with the object having been replaced with an event, and the property of bent-ness as having been replaced with the property of presentness

- (1) DQA at (present time) t is identical with DQA at (past time) t\*.*
- (2) DQA at t is present.*
- (3) DQA at t\* is not present.*
- (4) If DQA at t is identical with DQA at t\*, then DQA at t is present iff DQA at t\* is present.*
- (5) Therefore, DQA at t is present and not present.*

Craig presents Lewis’ (1986) position that there are three possible solutions to this problem. I am going to explain Lewis’ three possible solutions to the problem of temporary intrinsics, as well as what Craig says about them, and then explain why the solutions are not applicable to the Presentist’s problem.

**The first solution** is to claim that the temporary properties “are not genuine intrinsic

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<sup>49</sup> This is a problem for change over time in general. I will not discuss this further. We will only focus on how this ties in with McTaggart’s paradox.

properties. They are disguised relations, which an enduring thing may bear to times” (Lewis 1986, 204). Lewis uses the example of a person having a bent shape when they sit, and a straightened shape when they stand. But how does this apply to McTaggart’s A-series properties? Craig claims that this first solution, applied to McTaggart’s paradox, would require us to say that “A-determinations are not intrinsic properties, but disguised relations to times. E, for example, may be present in relation to some time and future in relation to others” (1998, 124). But in a sense, this is what McTaggart has already done. As we have already discussed, McTaggart claimed that pastness, presentness and futurity “are not qualities [properties] but relations, though of course, like other relations, they will generate relational qualities in each of their terms” (1993 [1927], 31). However, McTaggart does not think that these A-series relational properties are relations between events and times, but rather between events and “an entity *X* outside the series” (1993 [1927], 32), which I have understood as the objective moving NOW.

However, Craig does not seem to consider this possibility: namely, the possibility of the A-series properties being relations between events and the *X* outside the time series. Craig only considers them to be relations that an enduring thing (such as an event) may bear to times – as per Lewis’ original suggestion (See paragraph above, and Lewis 1986, 204). So, Craig then claims that if these A-determinations are relations to times they must be relations to times in either the A or the B-series. But Craig notes what I have also noted earlier, that if the A-series determinations are to be understood as relations to other times (or events at times) in the time series, then they reduce to B-series relations and we lose the defining feature of the A-series – the objective moving present. For example, some event *E* will be present with respect to some other event *F* if both events are simultaneous, and *E* will be in the past of some event *F* if *E* is earlier than *F*, and *E* will be in the future of some event *F* if *E* is later than *F*. But then it follows that ‘present’ is reduced to ‘simultaneous with the indexical now’, future is reduced to ‘later than the indexical now’ and ‘past’ to ‘earlier than the indexical now’. This solution, then, reduces or translates the A-series positions to B-series positions, and as such avoids McTaggart’s paradox by dispensing with the A-theory’s objective, non-indexical, moving present, and hence does away with Presentism all together. Thus

we should not accept that Lewis' first solution can be applied to the problem of Presentism and McTaggart's paradox.

Skipping the second solution for the moment, **the third solution** offered by Lewis to the problem of temporary intrinsics, is to claim that things have *different temporal parts*. There is no problem in different *spatial* parts of a thing having different incompatible properties. A cow can be white at its front part and black at its back part with no contradiction, so can the cow not also be past at its March 3<sup>rd</sup> 2011 part, and future at its March 5<sup>th</sup> 2011 part? Perhaps it can. But what then of *events*, rather than *things* like cows? Can the event *E* not also be past at its March 3<sup>rd</sup> 2011 part, and future at its March 5<sup>th</sup> 2011 part? Perhaps it can on an Eternalist A-theoretic view which postulates that times, events and things other than the present do exist. But this solution does not work for the Presentist, says Craig, and I agree with him. This is because some event *E* need not persist over time at all, but could exist only at an instant *t*. On Presentism, the event does not exist through time, it only exists at an instant, and "because *E* does not persist through time, there is no place for a solution postulating temporal parts of *E* each having different intrinsic properties" (Craig 1998, 125). It might be replied that some events do persist over time,<sup>50</sup> such as the event of the tide going out. But Craig points out that, more importantly, the problem we see in McTaggart's paradox is not that an *event* has contradictory properties over time, but that it has them at an *instant*. Thus the third solution, which employs temporal parts, cannot be used to avoid the problem of temporary intrinsics as it appears in McTaggart's Paradox, with regards to Presentism.

Let us return to **the second solution** to the problem of Temporary intrinsic suggested by Lewis in Craig's paper. This is the solution that Craig thinks avoid McTaggart's paradox. This solution is to say that the only intrinsic properties something has are the ones it has presently. The Presentists and Craig's (1998) response to the problem of temporary intrinsics is to say that "the having of a property is a tensed having" and that "all the properties *O* has are the ones it presently has, and so no contradiction can arise

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<sup>50</sup> Robert Nola (personal communication 2012).

... even if O undergoes intrinsic change between  $t$  and  $t^*$  it nonetheless does not have (present tense) incompatible properties” (Craig 1998, 125). However, I maintain that Craig’s solution to the problem facing the Presentist does not succeed. Craig himself admits, “the A-theorist cannot understand grammatical ascriptions of pastness and futurity to events [events at times] in terms of the literal inherence of properties of pastness and futurity in events” and therefore we must parse them as ‘was’ or ‘will be’ (Craig 1998, 126). I want to now consider Oaklander’s reply to Craig to see why this solution does not succeed. Note also that Craig (1999) has written a reply to Oaklander, and I will also discuss why *Craig’s reply to Oaklander’s reply* does not succeed. In his reply to Craig’s (1998) paper, Oaklander asks: if we cannot take literally a time’s possession of the A-series properties, as Craig (1998, 126) has just stated “then how are we to interpret ascriptions ‘asserting that the item [moment of time or event] *was* or *will be* F’? In other words, what do the tenses ‘was’ and ‘will be’ represent?” (Oaklander 1999, 315). Oaklander proclaims that in order to answer this question we must look to Craig’s account of Presentism. Craig has claimed that “we can characterize Presentism by allowing tensed states of affairs to be constituents of possible worlds. A tensed possible world is then a maximal possible state of affairs at some time  $t$ . Tensed possible worlds which did, do or will obtain are tensed actual worlds” (Craig 1998, 126). This is similar to a move made by Bigelow (1991), which I will briefly discuss in the following section (§2.3.3), along with Oaklander’s (1994) reply.

Oaklander understands Craig to be saying that presentness moves along possible worlds, changing them from existing to obtaining, similar to a Moving Spotlight. But Oaklander then objects to Craig’s Presentism by claiming that “the appeal to tensed possible worlds that change from existing to obtaining as they become present, that is, as presentness moves along the series of possible worlds, reintroduces the myth of passage that Craig [and McTaggart] found problematic” (Oaklander 1999, 317). This is because, Oaklander explains, that we end up being left asking ultimately the same question that we did of the incompatible times, namely: “How then, can one and the same possible world (which exists whether or not it is present) have the incompatible properties of not obtaining and obtaining, or of not being actual and being actual?” (Oaklander 1999, 317). If Craig’s reply, as Oaklander suggests it is, is that the possible

worlds obtain *in succession* then we fall back into McTaggart's paradox because we are using temporal terms (like succession) which themselves need explaining, in order to explain other temporal terms (like 'was' and 'will be').<sup>51</sup>

Craig then replied to Oaklander's objections. In his second paper on this topic (Craig 1999), which replies to Oaklander's (1999) criticisms, Craig claims that Oaklander's understanding of his position is not correct, and thus that Oaklander's objection is not sound. Craig explains that "the key point is that tensed possible worlds are not abstract objects timelessly existing, but abstract objects which exist at times and endure through time". Craig then argues that Oaklander's objection must be "that *W* at *t* lacks the property of being actual, whereas *W* at *t*<sup>\*</sup> has the property of being actual; therefore *W* at *t* is not identical with *W* at *t*<sup>\*</sup>" (Craig 1999, 319). Craig then points out that "the solution is just Presentism once more. If *t*<sup>\*</sup> is present, then only entities which exist at *t*<sup>\*</sup> are real including [world] *W*. Therefore the only properties *W* has are the properties *W* has presently, including actuality. Thus *W*, like any entity existing at *t*<sup>\*</sup>, does not have incompatible properties." (1999, 319). However, I object that this is not the solution, but rather this is simply the problem all over again – as I will explain shortly. Craig also replies that "Oaklander does not dispute the more fundamental point that on a Presentist ontology neither the problem of Temporary Intrinsics, nor McTaggart's paradox arises" (1999, 319). However, this is precisely the point which Oaklander does dispute, as I have just explained. Additionally, Craig replies that his "characterisation of

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<sup>51</sup> Oaklander actually claims "to explain *when* possible worlds obtain he [Craig] appeals to succession, but since the appeal to succession implies the reality of B-relations, Craig's Presentist ontology is not a pure A-theory, but a hybrid A-B theory, which is by his [Craig's] own lights, susceptible to McTaggart's Paradox" (Oaklander 1999, 317). This is because Craig has claimed that views which include moments other than the present (or what he calls hybrid A-B theories) are prone to McTaggart's paradox. However, if we accept my method of classifying views on time, then there is no such thing as a hybrid A and B theory, they are instead hybrid A and Eternalist theories. This is because what it is which the A-theoretic views other than Presentism incorporate, is not a B-theoretic picture (which denies passage), but an Eternalist picture (the existence of moments other than the present – or at least of past moments of time, if not of present moments).

Presentism in terms of possible worlds is not meant to *explain* why only the present exists or to *found* the objectivity of temporal becoming, but simply to provide a language in which to formulate such notions” (1999, 320). So be it. But in order to avoid McTaggart’s paradox one needs to give an account of the terms of *pastness*, *futurity*, *was* and *will be* which does not lead us back to the infinite regress. Giving an account of this is at the very heart of McTaggart’s paradox, and thus, if Craig hopes to show how Presentism avoids the paradox, he needs to do so.

Furthermore, I object that Craig’s solution has already been recognised and rejected by McTaggart himself: “It is never true, the answer will run, that M is present, past, and future. It is present, *will be* past, and *has been* future. Or it is past, and *has been* future and present, or again is future and *will be* present and past” (1993 [1927], 32). This is the same solution that Craig has given when explaining the Presentists’ stance. This solution leads back to the original problem that McTaggart’s paradox raises: an event must have all three incompatible properties in order that time has passage in the A-theoretic sense. But since an event cannot have incompatible properties we must qualify the statement by claiming that the event has the different properties at different times. However when the properties are themselves temporal properties or times, the statement becomes merely that different events (at times) have different temporal properties (or times) at different times. This can either be understood as a trivial claim (if ‘at times’ just refers to the same time), or as nonsensical (if it refers to different time and we do not employ the concept of hyper-time).

McTaggart’s paradox, the part that specifically refers to the incompatible properties and the resulting infinite regress, has three main steps, as follows:

- 1) Each event or moment of time must have all three properties, pastness, presentness, and futurity, in order that time passes. However, each event or moment of time cannot have all three as they are mutually exclusive.
- 2) The ‘obvious reply’ is to say that each event or moment in time does not have all the properties at the same time, instead it has them in succession. Event *e* at time *t*, was future, is present, and will be past – and there is no contradiction in



something (be it an object, time or event) having incompatible properties at different times.

- 3) The obvious reply results in the same problem we faced at step one. We are using the temporal relations to explain the temporal relations, “the nature of the terms involves a contradiction, and [...] the attempt to remove the contradiction involves the employment of the terms, and the generation of a similar contradiction” (McTaggart 1993 [1927], 33, footnote).

It seems that Craig does recognise the problem with step 1, and identifies that Presentism, because it denies the reality of the past and future moments of time, does not have the incompatible properties. However, in order to then allow Presentism to still have a passage of time, and not be simply a static view – as is necessary for it to qualify as an A-theoretic view – it must somehow still allow for the properties of pastness and futurity. It seems that Craig recognises this too because he makes the move of employing the terms ‘was’ and ‘will be’ as suffixes to the use of the properties of pastness and presentness. But this move is the same as Step 2 of McTaggart’s Paradox – as I objected in the paragraph above – and McTaggart has shown how this move, in order to avoid the contradiction at step 1, gives rise to an infinite regress of explanation. However, Craig does not seem to recognise that McTaggart’s paradox is more than just the problem at step 1 and the reply at step 2, but that it necessarily involves a greater problem – that at step 3 – which Craig has not addressed. Craig’s attempt to show how Presentism avoids McTaggart’s paradox is simply a restating of the move made at step 2, which itself is part of what creates the very paradox he is hoping to avoid.

In order for an A-theoretic view to be one which includes passage it needs to be the case that each moment of time has the properties of pastness, presentness, and futurity. The problem is that if some moment does have those incompatible temporal properties, it generates the contradiction (at step 1) and the infinite regress (at step 3). There is no way around it: either we get the properties which allow for the passage of time and then we also face McTaggart’s paradox; or, we avoid the problem by denying the existence of the past and future moments and denying the properties of pastness and futurity, and we are left with a static Presentism. In his ontology, Craig wants to

include the properties in order that Presentism includes the feature of passage – as seen by his employment of ‘was’ and ‘will be’ (Craig 1998, 126) – yet he also wants to deny the properties in order that Presentism avoids McTaggart’s paradox – as seen by his claim that “the only intrinsic tensed properties there are the present-tensed and therefore compatible” (Craig 1998, 126). It seems that Craig is picking and choosing. But he cannot include the contradictory A-series properties in his ontology when it suits him, and leave them out when it does not.

### 2.2.3. *Worlds Enough for Presentism*

Since the first account of Possible Worlds Presentism as a way to make sense of the passage of time was given by Bigelow (1991), I will say something here about Bigelow’s account. I believe that it also fails to avoid McTaggart’s paradox, and I will explain why with reference to Oaklander’s (1994) criticism of Bigelow’s account. However, to some extent this move has been explained and refuted in the section above, so this will be covered somewhat briefly.

The motivation for Bigelow’s attempt to account for the passage of time by using possible worlds, is that if some moment or event “was present, then clearly it is *possible* for it to be present, and that means (in other words) that there is a possible world in which it *is* present” (1991, 5), and thus “McTaggart’s assumptions entail the modal solution” (1991, 6). Bigelow claims “The only way to sublimate this [McTaggart’s] contradiction is by saying that each moment is past and present and future *relative to* different points of references”, and they can’t be moments of time because “this presupposes what we’re trying to explain”. So “We just need to find points of reference other than moments of time. I [Bigelow] nominate possible worlds” (Bigelow 1991, 5). However I believe that it is not just a matter of finding points of reference other than moments of time, because as I will show (with appeal to Oaklander) even *that* will result in the paradox. The point is we can’t get out of the paradox.

Bigelow’s solution is to say that “if a thing *a* is present in world *w*, then *there is* a world in *w*’s past for which *a* is future, and there is a world in *w*’s future for which *a* is past”

(Bigelow 1991, 13). Or to put this another way, “What is present ... has the property of presentness in world  $w$ , has the property of pastness in a world  $x$  in  $w$ ’s future, and has the property of futurity in a world  $v$ , in  $w$ ’s past” (Oaklander 1994, 245).

Oaklander considers a number of ways of interpreting Bigelow’s Possible Worlds account of the passage of time, and objects to each of them in turn. The first objection that Oaklander makes is that if we interpret the worlds in  $w$ ’s past and future as just *possible* and not actual “then there is no passage because the self-same event does not actually change its temporal properties”. Oaklander gives the example of an apple being red in one world and green in the other. This does not constitute change over time “unless the possible world becomes actual later than the ‘currently’ actual world” (1994, 246). (I will come to what is wrong with *that* interpretation in just a moment.)

Secondly, “If only one world is actual then ... there is no tensed time and change” (1994, 246). The paradox is solved by resorting to the B-theory. Alternatively, “if both [or all] worlds are (tenselessly) actual, then there is no world picked out as now” (1994, 246). Lastly, if all the worlds are current or actual, then we arrive at the original problem of the contradictory properties. This is because the event (or thing, or moment) has the properties of pastness, presentness and futurity, and thus we are back at step one: the original problem of McTaggart’s Paradox.<sup>52</sup>

Here is where this ties in with my objection again: We might want to add that the ‘obvious response’ to this conflict is to point out that the worlds are actual *in succession*. Or as mentioned above, the “possible world becomes actual later than the ‘currently’ actual world” (1994, 246). This is analogous to the move made at step two of McTaggart’s Paradox, and this *would* avoid the conflict between the properties, and it would also allow for passage. But the problem with this solution is that if the worlds are actual in succession then we are faced with the same problem we face in step three, namely that we are employing succession or passage to make sense of our account of passage, and hence the solution faces the problem at step one again! Oaklander makes

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<sup>52</sup> See section above for reference to the 3 steps of McTaggart’s Paradox.

this point simply: “If all worlds are actual, then a contradiction results”: we are left in the paradox.

Oaklander makes a number of small objections against Bigelow’s Possible Worlds Presentism, or Possible Worlds account of the passage of time, but the one that really hits the nail on the head is the fact that the worlds have to become actual in succession in order for there to be any kind of passage and change over time, but that “in order to account for temporal passage, possible worlds themselves must undergo temporal becoming, then a meta-series of possible worlds...must exist” (Oaklander 1994, 247). But this is just a possible world analogue of McTaggart’s paradox. Employing a meta-series of possible worlds is the same move as employing a meta-series, or second level, of time in order to make sense of the passage of time, as per Broad (1923) – which I will discuss in the next section – or the same move as employing a second level of temporal properties, as per McTaggart. Thus we can see that the Possible Worlds solution to McTaggart’s paradox simply falls prey to the paradox again.

Here it is worth briefly mentioning Ersatz Presentism. Instead of appealing to tensed properties in the present (as per standard Presentism) or possible worlds (as per Possible Worlds Presentism) for facts about the past (and future), the ersatz Presentist appeals to ersatz worlds or times. Ersatz times are abstract objects that exist in the actual Present moment and represent the ways things were (and will be) (Bourne 2006; Crisp 2007; Meyer 2007). I take it that Ersatz Presentism is akin to Possible World Presentism because like Possible Worlds Presentism it replaces the temporal properties and facts of traditional Presentism with modal ones; it appeals to a modal analogue of the temporal case. However, as Miller points out, “the ersatz Presentist must also introduce an ordering relation on the ersatz times which is analogous to an earlier and later-than ordering so that she can say that ersatz time  $t$  is later than ersatz time  $t^*$ ” (2005a, 355). Any A-theorist will need this, and more, in order to preserve passage – one of the key tenets of their view. The Presentist, be he an Ersatz Presentist or any other, must postulate the existence of times other than the present, in order that there be times that undergo A-series change. The problem that McTaggart’s Paradox highlights is that passage requires these times to have the incompatible temporal relations of the A-series.

It is no use saying that these times are not actual times and that they are only possible times or ersatz times. The Presentists cannot have their cake and eat it too, as it were. They cannot both postulate times other than the present so that they can have A-theoretic change, while also not postulating such times so that they can avoid McTaggart's paradox. Even if times other than present exist only as possible times or ersatz times, they are still subject to the law of non-contradiction and cannot possess the mutually incompatible A-series properties. I do not believe that there is any form of Presentism, or any other A-theoretic view for that matter, which can escape the objection raised by McTaggart's Paradox.

### **2.3. Price's Objection to the Notion of an Objective Present**

Now that we have done away with the possibility of Presentism avoiding McTaggart's paradox, let us consider another problem that faces the A-theory; one which also arises out of the A-theoretic notion of objective present.

Price uses CD Broad's *Moving Spotlight* view to highlight some problems that the A-theory (or specifically the notion of an objective present moment) faces. The Moving Spotlight view is an Eternalist view, so it is a view in which we suppose that all of the world's events exist, in something like the B-theorist's space-time manifold, and yet we suppose that along this linear manifold there is an A-theoretic objective present moment which moves in a certain direction. Broad says

*"we imagine the characteristic of presentness as moving, somewhat like the spot of light from a policeman's bull's-eye traversing the fronts of the houses in a street. What is illuminated is the present, what has been illuminated is the past, and what has not yet been illuminated is the future."* (Broad 1923, 59).

But Price claims that there is

*"something deeply puzzling about Broad's metaphor, however. After all, place yourself at any moment in time, and ask yourself 'Is this moment the present moment?' The right answer, obviously, is 'Yes' – a fact guaranteed by the stipulation that you are to ask the question of a moment, at that moment. But this means that if the houses in a street are to play the role of moments of time in Broad's analogy, then the answer to the question,*

*‘If you place yourself in one of the houses, and open the front door, will the policeman’s bull’s-eye be shining in your face?’ must also be ‘Yes’ – which means that the light must be shining on all the houses, not just on one!’* (Price 2009, §2)

There are two claims made here which are worth expanding on a little more. The first is that if you place yourself in one of the houses and open the door the light will be shining on you. This is true because the light represents the present, and the only moment in which events can happen is the present. So necessarily if I am opening a door to a house, or doing any other action for that matter, I must be doing it in the present, and not in the past or the future. Now, put the house metaphor to one side, and consider real life. I can at any moment act, yet at any moment when I act, acted, or will act, that moment is present. I cannot act in the past or the future. Necessarily all actions occur in the present. So therefore, in the metaphor, whenever I open the door of a house (or act), I will find that the spotlight is shining on me (it is present).

The second claim is that the light must shine on all the houses and not just one. This is true for two reasons. Firstly because the A-theorist does not want a static present, but a passage of time. Secondly, if it is the case that one can only perform actions when it is the present (when the light shines on the house), as we have just established, and supposing that I can perform an action at each and every moment (I can open the door of any house) then it follows that each moment is present, that each house has the light shining on it. Before the reader cries, “the light is not shining on all the houses at once!” – just wait, for this is the ‘obvious reply’ we saw at step two of McTaggart’s Paradox (see my §2.3.2 above), and which I will return to two paragraphs after the next.

Price claims that the conflict here seems to arise from the fact that the Moving Spotlight view (and also the Growing Block and Branching Tree views – as we will see in the next section) attempts to mix what Price calls an ‘exclusive’ view on the present moment, with an ‘inclusive’ view. The Moving Spotlight view wants to claim that one moment is exclusively the present moment, because as an A-theoretic view it holds there is an objective present moment. Yet the view also wants to allow that all moments “get their turn” at being the present moment. So in this sense it is inclusive, and it needs to be in order for time to have passage (in order for the spotlight to move),

because otherwise we have a static A-theoretic view. Thus it is this mixture of *inclusivity* – all moments get their turn at being present – with *exclusivity* – only one moment is present – which causes the conflict (Price 2009, §2.2).

The obvious reply that one might give to Price's objection that each house, not just one, is illuminated, is that each house is illuminated by the spotlight *successively*. No conflict arises when we point out that the houses are not illuminated at the same time as each other, so in order to avoid the conflict we need to add a "temporal stipulation to the question about what you see when you open the front door...Will you see the light? Perhaps, but it depends on when you open the door" (Price 2009, §2). This move is analogous to the move made at step two of McTaggart's paradox: having the contradictory properties of pastness, presentness and futurity is no problem if the event or moment of time in question has them in succession. Likewise, all the houses on the street having the property of presentness, or being illuminated and not illuminated is no problem if they are present (in the spotlight) in succession. And indeed this is how we tend to conceive of the houses in the metaphor, I think.

However, this reply makes a mistake, the mistake made by the 'obvious' reply. The houses themselves are supposed to represent the series of moments in time, so we cannot ask "*when* do we open the door?". In order to do so we would then need to add a second temporal dimension or parameter to represent the moments or times at which the houses (which are themselves moments or times) are illuminated by the spotlight of the NOW. Again this is analogous to McTaggart's paradox. In McTaggart's paradox, the next move that is made is to employ a second level of temporal properties ('is', 'will be', and 'has been') in order to explain the first (pastness, presentness, and futurity). In Broad and Price's house metaphor we employ a second dimension or parameter of time in order to make sense of the first. In McTaggart's paradox we employ a second level of temporal properties in order to make sense of the first. This akin to what is called a 'revenge paradox' in logic, whereby the attempt to solve a paradox results in the solution displaying the same, or an analogous, paradox.<sup>53</sup>

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<sup>53</sup> See Beall (2008; 2011) for further discussion of revenge paradoxes.

While it may seem at first as if the obvious solution is to employ a second temporal dimension or parameter in the house metaphor, it should not to be accepted so fast for two reasons. Firstly, what reasons do we have for thinking that in reality there are two temporal parameters? It is not clear that there are independent reasons, besides the fact that it gives a nice solution to the little paradox that has arisen. Price claims that some writers may be, or have been, prepared to ‘bite this bullet’ in order to save the notion of the objective moving present. But, not only does it seem an unjustified move, Price believes that this option is “neither appealing nor promising” (2009, §2).

Secondly, the nice solution that we may have adopted in order to save our notion of the objective moving NOW is not so nice after all. The solution means that we adopt a second temporal dimension or parameter (hyper-time) in order to help understand the notion of the first. But now we are facing the same problem as we did with McTaggart’s story of the moving NOW. We have adopted a second time parameter, or a second level of temporal properties in order to explain the first (Price 2009, §2.2.1; McTaggart 1993 [1927], 33). But in McTaggart’s Paradox, the second level of temporal terms then also needs explaining, leading us to employ a third level of temporal terms, which, like the second and the first also needs explaining, and so on, *ad infinitum* (analogous to a revenge paradox). Likewise with the problem that faces the Moving Spotlight, our employment of a second temporal dimension or parameter in order to allow us to make sense of the passage of time within the first, will then face the same problem that the first level did, and thus a third level of time – a third temporal parameter or dimension – will need to be employed to explain the second, which is being used to explain the first.

It should also be noted that the alternative is not available to the A-theorist either. Any attempt to say that we do not need to explain when the spotlight is on which house, and that simply it is NOW when it is NOW, will lead us to a B-theoretic indexical account of presentness (of being in the spotlight), which, while it may be the way to go, it is not the answer available to an A-theorist. This is because the A-theorist believes that being present is an objective feature of reality, and not merely an indexical feature.



As Price says, the A-theorists would then be throwing out the whole bathroom with the bath water, not just the baby.

So, if the A-theory, by definition, entails an objective moving NOW, and the notion of an objective moving NOW leads to a contradiction, an infinite regress, and an absurdity – as we have just seen, by appeal to Broad’s metaphor – then we should do away with the A-theory and not accept it as a viable metaphysical view on the nature of time.

#### ***2.4. A Brief Note on Hyper-Time***

I have said above (see §2.3) that one way to avoid McTaggart’s Paradox would be to employ a second time dimension or hyper-time, but that this would result in McTaggart’s paradox again. Skow (2012) has fleshed out the notion of hyper-time a little more in his attempt at giving a new version of the Moving Spotlight view. But as I said above, I believe that the notion of hyper-time leads us straight back to McTaggart’s Paradox. I have also claimed that employing it as a solution is unjustified, while Price claimed doing so was “neither appealing nor promising” (2009, §2), so there are plenty of problems for the notion of employing a hyper-time. In his paper “Inconsistency in the A-theory” (2011) Smith has presented four objections to the notion of a hyper-time. His first objection is that hyper-time is ontologically extravagant, while his second is, like mine, that employing hyper-time as an explanation of passage then requires an infinite regress of hyper-times: “hyper-time, if it is to be worthy of the name ‘time’, must also flow: there must be an objective hyper-NOW, and it must move through hyper-time. But in order to make sense of this we shall require hyper-hyper-time...” (2011, §2.2). Thirdly, Smith then makes a claim that one motivation for the A-theorists to reject the B-theoretic picture is that they feel it does not account for the phenomenology, the feel, of the passage of time, but Smith objects that “the objective movement of the NOW through normal time, as hyper-time passes, provides no explanation of the phenomenology of time’s passing” either (2011, §2.2). However Smith believes there is a further, fourth and bigger problem for the A-theorists’ hyper-time, Smith claims that the problem is that “there is no basis in the A-theory plus hyper-time picture for the idea that we are stuck in the objective now” (2011, §2.2). He justifies this by asking and

pointing out “What happened to the persons in 1800 as the now moved? *Nothing*. At hyper-time  $t_2$  they are still there, in 1800, doing exactly what they were doing at  $t_1$ ” and that “if one also has a non-physical ‘non-detecting’ faculty, it too is in the same state in 1800 at  $t_2$  as in 1800 at  $t_1$ ”. As we will see shortly (see my §2.5.), this is somewhat analogous to an objection made by Braddon-Mitchell to the Growing Block view. Braddon-Mitchell has claimed that on the growing-block view, not only can we not know that it is now, now, but it almost certainly is not now, now. An important feature of both Braddon-Mitchell and Smith’s argument here is that if we take some moment, it will be true when that moment really is present, as well as when it is in the past, that at that moment there was someone thinking it is present. But because facts about that moment do not change, it will always be true of that moment that some person is thinking that they’re present, and there will be some moment in hyper-time when they are right, and some when they are wrong. I will explain this further in the following section. I will also show that this problem arises because of McTaggart’s paradox, but, as I have already argued, we are not able to employ a second time dimension or hyper-time to avoid this paradox. I will not consider any further objections to the notion of hyper-time as I think the fact that it falls into McTaggart’s paradox again is sufficient to reject it. So let us move on to Braddon-Mitchell’s argument now.

## 2.5. Braddon-Mitchell’s “Is It Now, Now?” Objection

In this section I am first going to explain what I will call the “is it now, now” objection to the growing block view. I will first present and explain Braddon-Mitchell’s original argument. I will then show how making sense of the growing block view and the argument against it requires us to employ a second temporal parameter or hyper-time. Lastly, I will show how this leads us back to the problems raised by McTaggart’s paradox.

In his paper, “How do we know it is now, now?” (2004) Braddon-Mitchell presents another problem for the A-theory. Braddon-Mitchell claims that on the Growing Block view (or what he calls ‘The Growing Salami view’), not only can we not *know* that it is now, now, but also that it is almost certainly *not* now, now. He begins by outlining the

Growing Block/Salami view. While the past exists as a four dimensional space-time manifold, on the Growing Block view, the future does not exist and the present is “a kind of hyper-plane that borders reality” (2004, 199), the present is what is often referred to by Philosophers as ‘the crest of the wave of being’, as it moves along future moments of time come into being or existence with it.

Braddon-Mitchell asks how the Growing Block advocate can know that it is now, now. His ultimate conclusion is not only that they cannot know that it is, but that on the Growing Block view, it almost certainly is *not* now, now. As Braddon-Mitchell explains, the *Presentists* can say that we can know it is now, now, because only the present moment exists so the present moment is the only moment there is, hence the only moment it can be at that point in time is the moment which is the present. But the Growing Block advocate cannot do the same because there are equally real moments of past time on his view. The Four-Dimensionalist or B-theorist claims we can know that it is now, now, because ‘now’ is simply an indexical, “‘Now’ just means the moment at which it is thought or uttered. So people at any location in space-time who believe that they exist in the present, will believe correctly” (2004, 199). But unlike the B-theorist, the advocate of the Growing Block universe holds that there is an objective, non-indexical matter as to which of the moments is the present, namely the moments at the crest of the wave of being, and so they cannot adopt the indexical solution.

The follow passage illustrates the problem.

*“A little over 2000 years ago Caesar is crossing the Rubicon, believing he is doing so in the present. He is wrong. Of course once he was right: there was a time when that moment was the last moment of being, and then he was crossing the Rubicon in the present. But that time is gone”* (Braddon-Mitchell 2004, 200).

At every moment in time we think it is the present, and moments in time do not change what happens in them, the only thing that changes is their relation to what McTaggart calls X, or the moving NOW.

By this I mean that at 12:15pm on 2<sup>nd</sup> June 1908, Jimmy thinks that it is present – but it will be true that he thinks it at that moment in time when that moment really is

present, as well as when it is a million years in the past. (This is similar to the point that we earlier saw made by Smith: “What happened to the persons in 1800 as the now moved? *Nothing*. At hyper-time  $t_2$  they are still there, in 1800, doing exactly what they were doing at  $t_1$ ”(2011, §2.2)). This is because it is still true that in that moment, the moment of Caesar crossing the Rubicon, and the moment of 12:15pm on 2<sup>nd</sup> June, that Caesar and Jimmy, respectively, think that that moment is present. In fact, at each moment in their lives, they probably thought that it was the present moment then, and not some other. But even as the objective NOW moves on to future other moments, it is still a fact about that moment that the people at that moment had thoughts at that moment, and some of thoughts will be that that moment is present. So, at any moment in the past, (some of) the people at those moments will be thinking that they’re in the present, but they will be wrong, because the objective NOW has moved on. That thought (the thought that it is present) will only be true when that moment is really present, but not true when the endless other moments in the future of that moment, are each, in turn, present.

But as Braddon-Mitchell then points out, there is a further problem: *We* do not know that it is now, now. This is because, if Caesar can think at that moment that it is the present, but be wrong, then we too could be wrong in thinking that this moment here in time<sup>54</sup> is the present. We have access (via memories, causal effects, history books etc) to the past, we know that it exists (or at least know that it *did* exist) so we can know that

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<sup>54</sup> I am using the phrase “here in time” to refer indexically to a moment in time, rather than using “now” both as an indexical, and as a non-indexical word picking out the moment that is the present. It is these two uses of the word “now” that allows us to ask the question “How do we know it is now, now?” This question is not a trivial question based on something’s necessary identity with itself, rather the two uses of “now” are not equivocal. “It seems there are two kinds of time: time understood as location in the four dimensional manifold that is the present and past, and objective time which tells you where the border is” (Braddon-Mitchell 2004, 199). Thus we can read the question as “How do we know this moment in space-time is the moment that is the objective present?” Forrest (2005) makes use of two nows:  $Now_i$  (indexical now) and  $Now_b$  (border of reality now) to disambiguate. I use NOW capitalised to highlight when the word ‘now’ is being used in a noun to pick out the objective present.

none of those moments are present, and that the people at those moments, like Caesar, are wrong to think it is the present. But at any moment in time, from the perspective of that moment we have no access to the future, so either way we cannot know if this moment at this point in time is the further-most moment, the moment at the crest of the wave of being.

*“While we can tell that the objective present is not located in the past-directed volume of space-time from our perspective, there is no reason ... to think that the objective present is not located at any particular point in some volume of space-time that may lie in the future direction from us ... we would need to know that there is no future-directed volume, and we have no independent access to this.”* (Braddon-Mitchell 2004, 200).

The only moment that Caesar was right to think that it was present, was when it *was* present, was when the moment that he thought that it was present, is simultaneous with the spotlight of the NOW, or the crest of the wave of being. We might want to say that Caesar was right at every moment to think that that moment was present. But, he was right to think that that moment was present only when it really was/is present. But then we may ask: at which moment is it present at that moment? Such a question illuminates the fact that I need to employ a second temporal dimension in order to make sense of the first.

There is a moment in hyper-time at which the crest of the wave of being (or the spotlight of NOW) is simultaneous with (or illuminating) the moment at which Caesar is crossing the Rubicon. And it is only then that he is right to think that he exists in the present. Once the crest of the wave of being, or the spotlight, has moved on, he is wrong. But it is an eternal truth that at that moment he thought it was present. So at some moment (in first level time) he thought it was present, and at some moments (in second level time) it will be true, and at others false. To illustrate this further, think of a film running through. Let's say it is a movie of Caesar crossing the Rubicon, amongst other things. Suppose it is 1 hour 20 minutes into the film at which Caesar crosses the Rubicon. We can ask, at what moment is that moment (Caesar's crossing of the Rubicon at 1:20) present? Supposing we started watching the film at 6pm on the 4<sup>th</sup> June, we can then say that Caesar's crossing of the Rubicon at 1:20 is present at

7:20pm on the 4<sup>th</sup> June. The filmstrip represents the first level of time, while our time outside the film represents the second.

So it seems that asking when something is present requires us to employ a second time parameter, the one in which the film is running, in order to make sense of when the things within the film are present. Likewise with Broad's houses and the Moving Spotlight from Price's objection: while the houses themselves represent moments of time and the spotlight represents the present, we need to imagine those houses and the event of the spotlight being on a house as happening *in time*, even though they themselves *represent time*.

There are some responses that can be made to my example that employs the film as a conceptual tool. Firstly, it will be replied, that Caesar's crossing of the Rubicon, as well as our existence in the 21<sup>st</sup> century, is not a film of time within time, but real life. There is no second level of time within which our time exists. And as I have already argued in §2.3, we are not justified in employing the notion of a second temporal parameter or hyper-time merely because it solves the problem. This leads us to the second reply that might be given: Even if we ignored that fact and employed the second temporal parameter or hyper-time then we would face the same problems that we faced with McTaggart's paradox and Price's (and Broad's) Moving Spotlight view. Namely, we are able to ask of the *second* level of time, the same questions that we asked of the first. This becomes analogous to McTaggart's Paradox; we have used the notion of the passage of time (at the second level) to make sense of the notion of the passage of time (at the first level). But the same problems arise at the second level as they did at the first. Namely, when is that second level time present? And we are back to level three of McTaggart's Paradox (see my §2.3.2).

However, if we remove the second level of hyper-time and just have the film running, or have time running, without that second level, then there is no answer as to *when* it is present (as to which moment in the film is NOW). If there is no fact of the matter as to which moment is present then we cannot hold the A-theory and must resort to a B-theoretic account of the present as an indexical truth.

To some extent, this was a digression from Braddon-Mitchell's objection that we cannot know when it is NOW. I took this one step further by showing that the question of when it is now, now – let alone whether we can *know* it – only makes sense by employing a second level of time (or a *hyper-time*) in which the first passes, but that this results in an analogue paradox to that of McTaggart and the notion of an objective present.

### 2.5.1. A Quick Note on the Dead Past Reply

Forrest (2005) objects that Braddon-Mitchell's objection does not hold. He presents his Dead Past Hypothesis as the reply which saves the Growing Block view. This is the crux of his reply:

*“Life and sentience are, I submit, activities not states. Activities only occur on the boundary of reality, while states can be in the past. This in turn is due to the ‘causal frisson’ that Braddon-Mitchell mentions (2004: 201). If x causes y then in the normal case y is after x. If there is a precise moment at which x ends then y begins only after that moment, not at it. At the precise moment of the end of the cause there is as yet no effect. Hence there is neither the state of affairs of x causing y nor the state of x having failed to cause y. In that situation, x has, however, a causal property, the tendency to generate an event of type Y where Y is the type to which y will belong. By causal activity I mean the occurrence of such tendencies at a time too early for it to be the case that there has been a causal relation or to be the case that there has not been one.” (Forrest 2005, 359)*

Forrest believes that we can therefore conclude that “life and sentience are causal activities. The past is then dead” (Forrest 2005). Here we can see that Forrest is presenting the Growing Block view as a view makes the present ontologically significant in a way that the past is not. If we accept Forrest's defence we can say that we are able know that it is NOW, now because knowing is an activity that can only happen in the present, on the boundary of reality. Secondly, Forrest replies to Braddon-Mitchell's objection that the Growing Block view is not compatible with relativity theory, and attempts to reconcile the two by something that looks a little like a local passage account. I will not discuss this part of Forrest's reply because, given the lack of

resolution between relativity theory and quantum theory, we cannot (presently) justify our metaphysical theories due to an appeal to theories in physics – as I will explain a little further at the end of §2.7.

A move which makes the past ‘dead’ and the present the only moment that is alive is more analogous to a Presentist account than a Growing Block account, and this is the problem with the dead past reply. That is because, one reason to prefer the Growing Block view to a Presentist view is that the Growing Block view avoids the grounding problem that the Presentist faces. The grounding problem is the problem that the Presentist lacks an account of the truthmakers for past tensed statements. This is the point that Heathwood (2005) makes in his reply to Forrest. In order for Forrest’s version of the Growing Block view to avoid Heathwood’s objection, Forrest must import all of the “semantic and metaphysical gymnastics” (2005, 250), such as those explained by Bigelow (1996), so that he may then avoid the grounding objection.

In his reply to Heathwood, Forrest (2006) claims that the Growing Block theorist “is committed to the zombiedom of the past” (2006, 161) and thus the sentence “Caesar was wet when he crossed the Rubicon” is made true by past objects, whereas the sentence “Caesar was conscious when he crossed the Rubicon” is not. Instead, the truthmakers for consciousness statements about the past supervene upon “incomplete causal processes” – a causal process is taken to be incomplete when the cause exists but not yet the effect. Forrest states that “I require that consciousness supervene on the occurrence of suitable causes without the occurrence of their effects. Given that thesis, consciousness ceases to be real as soon as the effect has come into existence.” (2006, 162). It would seem that Forrest has made a *reductio ad absurdum* of this own theory by requiring the Growing Block theorist to be committed to the claim that earlier temporal parts of us are philosophical zombies.

I will not go any further into the debate here as it is focussing on the grounding problem. I explained in §2.2.1 that I believe that A-theoretic views fall prey to a more important problem, namely McTaggart’s infinite regress. I take the regress to be a stronger objection than the grounding problem because it means that the views which



face it fail, not just because they cannot account for something, but because they are internally inconsistent.

## 2.6. Price's Objection to Objective Flow

As well as an objective present, the A-theory, by definition, also involves an objective movement of that objective present. Without that movement we would have an objective yet static present. Yet, like the notion of an objective present moment, the notion of an objective passage of time also faces at least one problem, as discussed here in reference to an objection from Huw Price (1996b, 2009).

Price asks us to put the notion of a *direction* of flow<sup>55</sup> aside for the moment, and focus just on the notion of flow, without a direction. Price objects that if it makes sense to say that times flows, then it must also make sense to ask how fast it flows, “which doesn’t seem to be a sensible question” (Price 1996b, 13; 2009, §4.1). It is not a sensible question because things that flow, pass or move, do so at a particular speed and speed is measured as a distance over time. So when we ask what is the rate or speed of the flow of time (or time’s objective present) we are asking what the temporal distance is that time’s objective present travels within a certain time period. Yet as I will explain shortly, I believe that such a question is reminiscent of the need for a second temporal dimension or parameter, as highlighted by McTaggart’s and Price’s earlier arguments against the A-theory. If there were two temporal parameters it might make sense to ask at what speed (distance over time) time moves.

Maudlin (2007) replies to the problem of the rate of time’s flow by asserting that there is nothing objectionable about claiming that time flows at one second per second. In fact, he thinks it is a necessary and an *a priori* truth. (“The Future is something which everyone reaches at the rate of sixty minutes an hour, whatever he does, whoever he is” said C. S. Lewis). To add weight to his reply, Maudlin makes an analogy with exchange rates between currencies. He explains that we can define a fair exchange rate

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<sup>55</sup> Chapter Four will extensively examine the notion of direction.

by their “equality of purchasing power”, by considering how much it costs to purchase a group of items in dollars, and then the same group of items in other currencies. Maudlin then asks us to consider what a fair exchange of dollars for dollars is – dollars of the same currency. “Obviously and necessarily, and a priori, one dollar per dollar. If you think that this answer is meaningless, imagine your reaction to an offer of exchange at any other rate” (Maudlin 2007, 112).

Price goes on to object to this. He asks us to imagine a graph of Maudlin’s exchange rate between currency X and currency Y with a straight line representing the fair rate of exchange between the currencies. When X and Y are the same currency the slope of the line will be 1. Likewise, we can graph an object’s flow or movement, one axis being the time it takes, and one the distance travelled. This is all well and good, but what happens when we consider what the two axes are to be in the temporal case, in the case of the flow of time. Price answers that one axis will represent the amount of time passed between two times  $t_1$  and  $t_2$ , the other measures the amount of time it takes for that amount of time to pass. “The problem is not that these amounts of time are necessarily, *a priori*, of equal length. The problem is that they are *the very same thing*” (2009, §4.1). To highlight his point, Price makes an analogy between this and a case where one informs a traveller that he travels at “a rate of one yard per yard traversed”, and that by the end of his journey he has “put behind him more than 500 miles, over a distance of the same magnitude”. This is an uninformative and tautological point to make to the traveller. Price goes on to explain that “Maudlin’s exchange rate example misses this point, because it provides two things to tally: the dollars you give me, and the dollars I give you”. But with the flow of time, and the distance the traveller travelled, it is not the case that there are *two things of equal* value, length, distance or time, instead only *one* thing is being compared to itself: time.

We may want to argue that we can avoid the problem of the two axes representing – not the same *kind* of thing – but the exact same thing, by employing a second temporal dimension, or a second level of super time. Therefore when one axis represents the amount of time passed between two times and the other measures the amount of time it takes for that amount of time to pass, we will be talking about two different kinds of

time. Consider a film. We may ask how long it takes to get from the birth of the child (in the film) to its second birthday. The answer would of course be two years. But it will not be the case that it takes two years for the child to age two years. Instead, we can make sense of the passage of time in the film, by comparing it to our passage of time. So we might answer that it takes 27 minutes (of our time) from the birth of the child to its second birthday (the film's time). In this sense, our time which is external to the film is like a kind of hyper- or super-time in which the film's time exists. Therefore, when we ask at what speed time flows – speed being understood as a distance travelled over a certain time – we will not be using the output of the equation, as part of the input, to work out the output! Thus, the question would not be circular, i.e., the equation would not be question begging.

But there is a problem with such a move. I believe that the problem of the flow of time, and the solution of employing a hyper- or super-time is analogous to the question that arises with Broad's Moving Spotlight view: what will "you see when you open the front door...Will you see the light? Perhaps, but it depends on when you open the door" (Price 2009, §2). Employing a second time dimension allows us to talk about time within time. The idea becomes conceptually coherent, in the same way that we can imagine time passing in a movie while we ourselves exist outside of the movie, yet in time – as above. However, the problem of the rate of time's passage is analogous to the problem of the Moving Spotlight view, in another way: adding the second temporal dimension leads to the same two problems that the Moving Spotlight view faces. Firstly, other than that fact that it might tidily solve the problem, it seems there is no independent justification for adopting a second time dimension. And secondly, even it were a justifiable ontological move, the second time dimension faces the same problems as the first: we end up with levels of imbedded houses within houses, in order to explain the passage of time. Just like McTaggart's infinite regress of levels of temporal properties, we would then need to employ a third temporal dimension in order to explain the rate of flow in the second temporal dimension, which in turn is being used to explain the rate of flow in the first.

To conclude, Price has claimed that if time passes, or flows, then it makes sense to ask at what rate it flows. However, Price has shown us that it does not in fact make sense to ask at what rate time flows, because as I have argued, we end up in the same quagmire that McTaggart and the Moving Spotlight view got into. If we are correct in the assumption that if time flows then it makes sense to ask at what rate, and as we now know that it does not make sense, then we can therefore conclude, via *modus tollens*, that time does not pass or flow.

## 2.7. Maudlin, Objective Passage, and the Foliation of Space-Time

The first ‘scientific’ objection which Maudlin presents against the notion of objective passage and hopes to then refute is one presented by Gödel, that “the passage of time requires some spatio-temporal structure forbidden by relativity” (2007, 115). Gödel writes:

*“The existence of an objective lapse of time, however, means (or at least is equivalent to the fact) that reality consists of an infinity of layers of ‘now’ which come into existence successively. But, if simultaneity is something relative in the sense just explained, reality cannot be split up into such layers in an objectively determined way”* (Gödel 1949, 557-8; as cited in Maudlin 2007, 115).

Maudlin postulates two questions that arise out of Gödel’s claim (Maudlin 2007, 116). The first is whether the passage of time implies a “foliation of space-time, i.e. does it imply that the four-dimensional space-time structure is split into a stack of three-dimensional slices in an observer-independent way?” The second is whether, if it does, this notion of the passage of time is in opposition to science’s understanding of space-time.

In **response to the first**, Maudlin replies that he can find no justification for Gödel’s “blank assertion that the ‘objective lapse of time’ is ‘equivalent’ to the fact that reality is a stack of ‘nows’.” Maudlin then claims that the passage of time provides “a fundamental objective distinction between two temporal directions in time”. It seems here that what Maudlin is saying is that the passage of time gives rise to a direction of time, the direction of time being understood as the direction of the passage of time,

which is a common way of understanding what the direction of time might be. But Maudlin then goes on to explain how we do not need a foliation of space-time – we do not need to be able to give an objective fact about which moments are simultaneous with other moments – in order that we distinguish between the two directions in time, and Maudlin adds “For even if we were to add the foliation, the crucial question of which events come first and which later would be unsettled” (2007, 116). But wait Maudlin! The question of which events come first and which later is a question about the direction and order of events in a time series, it is not a matter of the passage of time. It may very well be true that we do not need there to be objective simultaneity – a foliation of space-time – in order for there to be passage we simply need a general ordering or linear structure of events in time. Maudlin’s counter argument to Gödel is that direction of time does not imply a foliation, and while that may be true, I object that this was not Gödel’s claim. Gödel’s claim was that the notion of an objective present (regardless of it having objective passage or objective direction) implies that there is an objective fact about what events in the space-time manifold (in the temporal dimension) are present. The problem with simultaneity is that on a theory of relativistic space-time there is no fact of the matter about which moments are simultaneous (at the same time as, or present with) which other moments.<sup>56</sup> If there is going to be an objective moving present, then, given this, it would seem that there needs to be an objective fact about which moments or events in time are present and which are not. Thus it does in fact follow that there needs to be a foliation in order for there to be an objective fact about which events or moments in time are present and which are not, given that we are presupposing a relativistic account of space-time.

In **response to the second**, it is worth noting that we cannot appeal to physics to rule out the possibility of A-theoretic accounts of time. Currently there is no consensus in physics about which of the opposing accounts – the relativist or quantum theory – is the true account of the physical world. I take this argument from Monton who points out that “the actual physical theories that are utilized in doing metaphysics of this sort

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<sup>56</sup> See section 4.6.1 “Events in time that are not causally related” for a more in-depth discussion of simultaneity.

are almost certainly *false*. Our two best theories of physics, quantum theory and relativity theory, are incompatible” (2011, 143). While relativistic space-time does not appear to allow for any privileged reference frame, certain interpretations of quantum theory do, and therefore I take it that we can at most make a conditional claim about what would be compatible given than we are presupposing one account of space-time or the other.

## **2.8. Chapter Conclusion**

In this chapter I have shown how we should understand the notions of the A- and the B-theories, the former being that which is realist about the notion of an objective moving NOW or present, and the latter being anti-realist about it. I have also suggested that the term ‘Eternalism’ should be used to refer to notions which are also realist about moments other than the present moment, and that it should not be used to refer to the B-theory as there can be A-theoretic Eternalist views also. Given the way that I have classified the different view on the passage of time and on the existence of moments other than the present, I have generated a table and an axis representing the placing of the views on time. I believe my table of positions, and the way they can be represented on axis similar to that of the political spectrum axis, to be an *original* contribution to philosophy of time, as well as a *helpful* contribution given that acknowledging that there are *two* dichotomies, not one, can avoid certain ambiguities in philosophy of time.

My second goal for this chapter was to defend some arguments against the A-theory in general as well as specific A-theoretic views on time. I have paid particular attention to what is known as McTaggart’s paradox, the argument which shows that the A-series requires moments in time to possess incompatible properties, and that any attempt to solve or explain such a problem leads to further employment of those incompatible properties and an infinite regress of explanation. I have also shown how some other objections made against the A-theory and proposed solutions to those objections often take the form of a variant of McTaggart’s Paradox. For example, I have shown how the Presentists’ proposed solution to McTaggart’s paradox faces an analogue of McTaggart’s

paradox and does not solve the problem after all. I therefore suggest that we should reject the A-theory as a viable theory of time. I will follow on with this theme in the following chapter by combining some of the problems for the A-theory that I have discussed here, with the notion of time-travel that I established in the first chapter. I will also present some objections that apply to various forms of A-theoretic time-travel.

# 3 Time-Travel and the A-Theory

In the previous chapter I presented arguments as to why we should reject the A-theory as a reasonable metaphysical view of time. This chapter will combine time-travel from Chapter One with the A-theory from Chapter Two in order to further highlight the problems of the A-theory's defining feature of an objective moving NOW. I will look at two main ways of making sense of A-theoretic time-travel, and will reject each of these conceptions in turn. As an aside, we should remember from Chapter Two that we have defined the A-theory as any view that is realist about the passage of time, i.e., the movement of a single objective NOW.

The **first conception** interprets A-theoretic time-travel stories as either: stories in which the objective moving NOW continues on in time while the time-traveller goes back in time; or, as ones in which the objective moving NOW does not continue on in time like normal, but rather, goes with the time-traveller. They are stories in which each moment on the time line is not present in linear order; they are stories in which the NOW departs from its path in a way that is unlike the way the A-theorist would normally have us understand the movement of the NOW. I will discuss problems associated with this first conception in §3.1, §3.2 and to a lesser extent in §3.3. I will reject such accounts because I hold them to be nonsensical. This is because they require us to conclude that as well as people existing in the present (which is non-problematic), others *are* existing in the past or the future (rather than *were* existing in the past, and *will* exist in the future). I will show how conceptions of this first kind lead to absurdities, and that therefore we cannot accept A-theoretic, time-travel accounts of this sort. Note that while this interpretation does not seem to be held by any proponents of A-theoretic time-travel, such as Daniels (2012), Keller and Nelson (2001), and Monton (2003), it is at least a common pre-theoretic conception of time-travel on a moving NOW view, so it is worth examining and then putting aside.



The **second conception** of A-theoretic time-travel will be covered in §3.4 and §3.5. Proponents of this view would, like me, agree that we should reject the type of time-travel associated with the first conception.<sup>57</sup> They would say that when the time-traveller goes back in time, from  $t_5$  to an earlier time,  $t_1$ , it is *not* the case that when the time-traveller gets to  $t_1$  it is the objective present there at  $t_1$  (as per the first conception). If *that* was what was implied then it would follow that  $t_1$  was present *after*  $t_5$ , and it might be claimed that this makes a conceptual mistake. Rather, proponents of the second conception hold that what happens instead is that it *becomes the case* that the time-traveller *did* exist at  $t_1$  when  $t_1$  was the present, and that the cause (or one of the causes) of this fact is the events that happen at  $t_5$  (such as a departure event). The second interpretation is one in which some past or future moment is/will be/was present when the time-traveller gets to that moment (i.e., there is no NOW jumping around, and on this second conception, we accept the obvious solution to the nowhere argument). This second interpretation is, I think, a more promising interpretation of what is going on in A-theoretic time-travel, because, unlike the first conception from the first half of the chapter (§3.1, §3.2, and §3.3) it does not turn out to be nonsensical. The second conception, then, is a legitimate, and perhaps the most common, post-theoretic interpretation of A-theoretic time-travel stories, and seems to be the conception held by Daniels (2012), Keller and Nelson (2001), and Monton (2003).

However, in §3.4 I will argue that although the time-travel story given by Daniels and Keller and Nelson is conceptually coherent, it turns out to not count as genuine or strong time-travel as was set out in Chapter One. This is because, under this conception of time-travel the Presentist is committed to a certain understanding of the movement of the NOW which has implications for their time-travel story. I will show how such an account does not satisfy our requirements for a time-travel story (although it is

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<sup>57</sup> Proponents of this view are Paul Daniels (Personal communication, 2013; and Daniels 2012), and Keller and Nelson (2001). One would assume that others who endorse A-theoretic time-travel would follow this type of account.

something *like* a time-travel story), and also that such an account faces other problems (such as causation at a temporal distance). In §3.4.3 through §3.4.6 I will demonstrate that this is because the important feature of time-travel stories is the corresponding temporal ordering. The A-theorist must order events in time in virtue of their A-theoretic properties (pastness, presentness, and futurity) which are generated by objective passage or the objective moving NOW. Thus a coherent account of A-theoretic time-travel – such as that set out by Keller and Nelson or by Daniels – lacks the features required to be genuine time-travel, as set out in Chapter One. Likewise for Monton’s account of Presentist closed time-like curves. I will show that although Monton may succeed in showing that Presentism is compatible with closed time-like curves, his time-travel story does not satisfy the requirements for the definition of time-travel from Chapter One.

There is also a **third** possible conception of time-travel in which there is a present for the time-traveller *and* for the non-time-travellers. On this conception, these multiple presents can come apart, as set out in Lewis’s account (1976). However, notice that this type of interpretation takes an indexical rather than a realist account of the present moment, and is therefore not an A-theoretic time-travel story, and hence will not be discussed in this chapter. This chapter will only consider variations of A-theoretic time-travel; time-travel in a world with a single, objective, moving NOW.

### ***3.1. The Time-Traveller and the Objective Moving NOW***

The aim of this section is to address some questions about what happens to the objective moving NOW of the A-theorist, when the time-traveller goes back in time, as per the first interpretation. This section will pay particular attention to a combination of the A-theory and a problem presented in Braddon-Mitchell’s (2004) paper.

I intend to apply the problems that we have considered in the previous chapter – such as the ‘Is it now, now?’ problem – to time-travel. In the previous chapter (§2.5) we considered Braddon-Mitchell’s “How do we know it is now, now?” paper which presents (at least) two problems for the Growing Block view of time. He highlighted the

possibility that not only can we not *know* whether it is NOW, now (an *epistemological* problem), but also, it may not be the case that it is NOW, now (a *metaphysical* problem). The latter is the problem that the moment we indexically pick out as ‘now’ does not correspond to the moment of time illuminated by the spotlight of (or in co-presence with) the objective moving NOW. The objection is that we cannot know whether the indexical now and the objective NOW coincide on a Growing Block View (or a Moving Spotlight view), and in fact it is almost certain that they do not (as argued by myself in §2.5 and Braddon-Mitchell (2004)). Yet, (so the argument goes) the possibility that they do not coincide is an absurdity, and thus we should reject any view that commits us to such an absurdity. In this section I will primarily focus on the *metaphysical* problem raised by Braddon-Mitchell, namely that the objective NOW and the indexical nows do not coincide (rather than the epistemological *how do we know?* problem). Although Braddon-Mitchell’s objection was raised with regards to the *Growing Block* view (a view with a fixed past and open future), I hold that the same absurdity would apply on all A-theoretic views except Presentism. This is because, as we will see, the culprit is the objective moving NOW and its ability to separate from the indexical now. The only view that does not face this problem is presentism (as Braddon-Mitchell himself holds). This is because on Presentism the indexical now and the objective NOW necessarily always coincide, since only one moment of time exists.

Let us consider what happens to the A-theorists’ objective moving NOW when we attempt to apply it to worlds with time-travel. Let us consider what happens when, either, the NOW goes *with* the time-traveller, or, when the NOW continues on through time as per normal and the time-traveller travels to the (objective) past or (objective) future. To set up the problem, suppose that we do know which moment of time is objectively NOW – namely, that  $t_5$  is in fact NOW.<sup>58</sup> We may ask what happens when the time-traveller travels back to  $t_1$  (the objective past), from  $t_5$  (the objective present).

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<sup>58</sup> By this I mean that we consider the indexical now to be simultaneous with the objective moving now, or, the *edge-of-reality* now (if you are a Presentist, or a proponent of the Growing Block or Branching Tree), and if we assume that we are right in our assumption and it is in fact NOW, now.

There are four possible answers. The first three (conceptions 1a, 1b, and 1c) are variations of Conception One outlined at the beginning of the chapter which I will focus on here, while the third is Conception Two which I intend to leave till §3.4 and after.

The first possible answers, conceptions 1a and 1b, hold that the objective moving NOW continues to move forward in time as it normally would with  $t_6$  becoming present after  $t_5$ . Another possible answer, conception 1c, is that the objective moving NOW goes back in time just like the time-traveller and  $t_1$  becomes present after  $t_5$  is present. I will show that each of these possibilities is either problematic or outright absurd, thus giving a *reductio ad absurdum* of all these interpretations of A-theoretic time-travel.

Firstly, let us consider **Conception 1a**. Suppose that the objective moving NOW continues on as normal through time with the events coming into being, or becoming present, in the sequence:  $t_1$ ,  $t_2$ ,  $t_3$ ,  $t_4$ ,  $t_5$ ,  $t_6$  and so on. If the time-traveller travels back from the objective present at  $t_5$  to the objective past at  $t_1$ , we must say that the time-traveller has travelled back to the past and they are acting in the past. This seems very unusual. All actions are done in the present. It does not make sense to say that one is presently acting in the past. This scenario is in many ways analogous to the problem presented by Braddon-Mitchell in his paper “How do we know it is now, now?” where he concludes that it is “absurd” that the current moment be in the past (2004, 201); that the objective NOW is in the past of the indexical now. But this is almost certainly true on a Growing Block view. I hold that the absurdity of the objective NOW and the indexical now coming apart is made more absurd by the addition of time-travel. So we can conclude that possibility 1a highlights a *reductio ad absurdum* of one way of understanding time-travel on an A-theoretic picture, because it requires that the time-traveller is presently acting in the past.

Secondly, there is another variant of Conception One that applies instead to *future* directed time-travel, which I will call **Conception 1b**. Suppose someone time-travels forward in time, from the objective present at  $t_5$  to a later time,  $t_9$ , and experiences five seconds of personal time whilst time-travelling forward 5 years. If we understand the

objective moving NOW to continue on through time like normal (as is the stipulation for possibility 1), then the objective NOW will be in the *subjective* past of the time-traveller but also in the *objective* future. Consequently, the objective NOW and the indexical now do not coincide. The time-traveller's personal time NOW has parted company with the objective, moving NOW, raising issues about the possibility of really existing and acting when the objective NOW is not present.<sup>59</sup> This is because, after five seconds (which is the amount of personal time that it takes for the time-traveller to travel five years in external time), the objective moving NOW will presumably be simultaneous or co-present with a time five seconds after t5 (perhaps called t6).<sup>60</sup> Thus the time-traveller will be existing in the future, and again we arise at a *reductio ad absurdum* of the same kind as in previous cases.

Note that conception 1b is different from saying that the time-traveller *will exist* in the future. You might object that it is not the case that the time-traveller *is existing in the future*, but rather that once the time-traveller arrives at t9 it will be the objective present (i.e., NOW) there at t9, and not in the future. However, this interpretation is what I called Interpretation Two, which I will return to and consider in §3.4. I will reject Interpretation Two because it does not cohere with the definition of time-travel as set out in Chapter One. Let us leave this interpretation aside for the moment and I will reject it in turn.

The unusual thing about conception 1b in which the time-traveller goes to the future, is that the time-traveller will be an acting agent in the *future*, not in the present. Again we

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<sup>59</sup> See my §2.5 and Braddon-Mitchell (2004) for more on this.

<sup>60</sup> The point here is that the duration of the time-traveller's personal time does not match the duration of external time. As a result, this seems to mean that the time-traveller's personal NOW, does not match external time's NOW, and since there cannot be two NOWs on the A-theorist's view, this is what generates the problem. However, working out which moment in external time 'corresponds' to which moment of personal time, is to some extent nonsensical. Trying to develop a view to reject is difficult given that I do not think the view is coherent to begin with. Also note that §2.7, on A-theoretic views and the foliation of space-time, deals with this to some extent.

fall prey to the objection made previously when we considered possibility 1a. Specifically, the objection that on such a view we are committed to the absurdity that the objective NOW and the indexical now do not coincide. The agent (our time-traveller) will be acting in some moment other than the objective NOW. This situation is made even stranger if we take an open future view on which moments or times later than the objective moving NOW do not exist. This possibility is similar to that presented in Miller's (2005b) objection to open future time-travel, which I will return to and defend in §3.3.

The third possible answer, **conception 1c**, is to say that when the time-traveller goes back in time, the objective moving NOW goes with her. By this I mean that the time-traveller is somehow *temporally privileged* or special. The objective NOW is always co-present with the time-traveller's indexical now. I take it that there are two problems with this conception of A-theoretic time-travel. The first is that while the objections that were raised against conceptions 1a and 1b do not apply to the time-traveller, they here apply to the *non*-time-travellers. Let me take a digression so that I may then explain this problem further.

Grey (1999) presents what is called the Nowhere, or No Destination, argument against time-travel. This argument holds that time-travel is not possible on a Presentist picture because times other than the present do not exist, and thus there is nowhere for the time-traveller to travel to. It also applies to future-directed time-travel on open-future fixed-past views (such as Growing Block, or Branching Tree views). However, Dowe (2000) and Keller and Nelson (2001) have pointed out that the Nowhere Argument cannot be valid because it "proves too much" (2001, 335). What they mean by this is that if the Nowhere Argument were true it would rule out the movement or passage from second to second that is normal temporal existence on any A-theoretic view. Keller and Nelson say, were this true, Presentism would not even "make it to the starting line" (2001, 338). A-theoretic opponents of this argument claim that we should instead hold that the moment which the time-traveller travels to *will* exist when they arrive there. This is akin to the way that for us non-time-travellers the future will exist

when we get there – even if we are getting there via normal second-by-second temporal existence.

Suppose we accept this solution to the Nowhere Argument. Suppose we accept the claim that the past or the future will exist and be present when the time-traveller arrives there. Here we encounter **the first problem with Conception 1c**: What happens to the non-time-travelling people? Either, they are now in the past according to the perspective of the *forwards directed time-traveller* (but where in time are they with regards to the objective moving NOW?). Or, if we say that they are at the edge of being, and they are simultaneous with the objective moving NOW, then we have to accept that the time-traveller is existing in the non-existent future!

Alternatively, consider a *backward-directed time-traveller*, and suppose that she travels from  $t_5$ , which is the objective present, to  $t_1$ , which becomes the objective present once she gets there. What is going on with the people at  $t_5$ ? It was the present there, but now it is not. Do they still exist, and are they there in the future<sup>61</sup> performing actions in some moment other than the present, yet thinking that it is the present, leading us to the ‘Is it now, now?’ problem? Or, if it is an open future view, then perhaps these moments cease to exist, and we are faced with the same problems that I mentioned in regards to possibility 1b (which I will return to in §3.3). The whole problem could be made even more bizarre by considering how this would all pan out in a world with two or more time-travellers, especially if they time-travel in opposite temporal directions.

**The second problem with Conception 1c** is raised by Le Poidevin (2003, 177). Again suppose we take the solution to the nowhere argument, and we hold that although neither the past nor the future exist, those moments *will exist* when the time-traveller gets there. Le Poidevin claims that “[i]t would be very odd if reality depended on where

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<sup>61</sup> Or is it more correctly termed the past, since it was present and now is not? The answer will depend on whether we order the moments based on the sequence in which they become present. Or, if we suppose there is some underlying space-time structure that gives moments their sequence *regardless of* the (systematic or erratic) movement of the objective present across the sequence of moments come into presentness.

one happened to be” (2003, 177) in more than simply an indexical way (as there is no problem if we accept this in a B-theoretic indexical sense). He makes this assertion with regards to *Presentism*, and objects that we do not want reality to be real in relation to a certain temporal or spatial location. He gives a spatial analogy to illustrate the absurdity: “Big Ben is *real in London*, but not real in Paris” (2003, 177). While Le Poidevin uses this as an objection against Presentism, I think it can be used more generally as an objection to the notion that reality depends on where one happens to be, as is the case in possibility 2. It might be objected that while it is undesirable to have a world in which A-theoretic time-travel results in the objective present being dependent on the temporal location of some temporally privileged person or time-traveller, it is not logically impossible or incoherent. While this may be true, I do not think that the A-theorists want to resort to extreme or bizarre stories in order to include an account of time-travel on the A-theory.

In conclusion, it is a trivial truth that whenever you are, it is the present, and this is because one cannot exist in a moment of time other than the present. I argued this in Chapter Two where I defended the problems presented by Braddon-Mitchell (2004). Thus, the combination of time travel with the Growing Block view (and various other A-theoretic views) leads to contradictions or absurdities. So, *reductio ad absurdum*, we must reject time-travel on a Growing Block view – and any other A-theoretic views. The objection applies to all A-theoretic views because the problematic feature is the objective moving NOW, not the fixed past and open future.

Let us now consider another case in which the idea of an objective moving NOW results in a different sort of problem for the combination of time-travel and the A-theory’s objective moving NOW.

### **3.2. Dowe’s A-Theory and Loops in Time**

Dowe presents a time-travel story on an A-theoretic model in which there is a causal loop due to a wormhole. He calls this a “wormhole time machine”. While he does not take it to be so, I believe that his account illustrates another case of inconsistency of an



A-theory of time combined with the notion of time-travel, which is similar to that from §3.1. Dowe sets up his time-travel story as follows:

*“Consider a simple case of a loop in time embedded in a larger otherwise linear (that is, containing no closed time like curves) space-time. Suppose we have a time-shifted wormhole (a time machine). Suppose, for simplicity, that it is open at each end only instantaneously, that the spatial dimensions of the wormhole are shrunk to a point, and that there is a one way temporal direction through the wormhole [See figure 7] from  $d$  to  $e$  to  $b$ . This model is an abstraction of a wormhole time machine” (Dowe 2009, 659).*

Dowe talks about how we can understand this scenario on the three A-theoretic views: Presentism, the Growing Block, and dynamism (what I call the moving spotlight). I will only focus on the latter – on how we can make sense of this scenario on the moving spotlight view. This is because I am endorsing the view that the problematic feature is the notion of the objective moving NOW, regardless of whether or not past and/or future times exist (as per Presentism and Growing Block views). Let us now consider three ways we might understand Dowe’s loop in time.

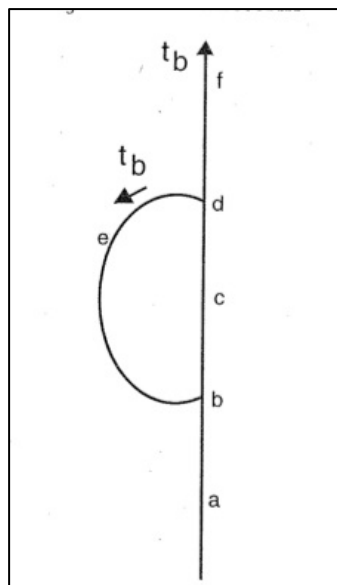


Figure 7: Dowe's loop in time.

On the first interpretation that Dowe considers, the **Bifurcating Eternal Return model (i)**, the NOW moves from  $a$  to  $b$  to  $c$  to  $d$  and then it bifurcates, Dowe explains. “[O]ne spot continues on towards  $f$ , the other encircling around the loop past  $e$ . The latter

passes *b* then *c* then at *d* it again bifurcates...” (2009, 662) and so on. It should be noted that while bifurcation can be understood as splitting or branching, this should not be confused with the branching on the Branching Tree model of time, because this is still a model of linear time, despite having a loop. On Dowe’s model, then, “[e]vent *a* is present once, events *d*, *b*, *e*, *c* and *f* are present infinitely many times. The wormhole is a now-duplicator. That is weird” (2009, 662). To understand Dowe’s model (i), suppose that we start by imagining that there is one NOW which starts at *a* and travels forward in time in a linear way. When it reaches *d* it will bifurcate, one NOW travelling forwards to *f*, the other travelling back around the loop past *e* and then joining the main temporal line again at *b*. That second NOW will go from *b*, through *c*, to *d* where it bifurcates (again), and one NOW continues travelling towards *f* as did the NOW before it. While the other NOW produced at the bifurcation event at *d* will go around the loop, join at *b* and bifurcate (the third bifurcation event) at *d*. And so on.<sup>62</sup>

We understand that if this process continues there will have been one NOW which passed over, actualized, or made present, the events and moments of time between *a* and *b*, so those moments or events would have only been present once. There will also be a single now which rotates around and around the loop (which includes *e*, *b*, *c*, and *d*) forever. But there will be multiple NOWs which pass over *f* and the events or moments which come after *f*. (The NOWs that pass over events or moments *d*, *f*, and those later than *f*, such as *g*, will be spaced apart at a temporal distance equivalent to the time between bifurcation events *d*, and the time it takes the NOW that goes around the loop to reach *d* and bifurcate again). How humans existing in this world would experience time is anyone’s guess, given that the A-theorists usual notion of a single objective moving NOW has implications for our experience of time and its (apparent) passage.

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<sup>62</sup> Note that there need not be a *time-traveller* travelling this loop in time. The important thing is that there is a *loop* there. However, there may need to be *something* travelling around the loop, because if there is not then the loop may not exist. This will depend on whether we take a substantivalist or relationalist view of the structure of space-time and hence whether we can have empty time; whether we can have temporal loops with no substance in them.

Notice that during my discussion I have been talking about the NOW moving through time as if it itself is an object that exists in time. For example, when I say that some event is present multiple times. Such talk highlights how the notion of the objective moving NOW does not make sense without employing a second time dimension within which the first exists. However, as I have argued in Chapter Two this is a problem analogous to the infinite regress that we face in McTaggart's paradox and is therefore a reason to reject A-theoretic conceptions of time.

Of his temporal loop story, Dowe states that:

*"Dennis Dieks's response is that 'this appears a reductio ad absurdum of the doctrine of the shifting now,' or '[a]t the very least one should say that an infinite multiplication of entities as necessitated by the moving now doctrine is a highly undesirable piece of metaphysics'." (Dowe 2009, 663).*

But Dowe holds that while it is weird, it is not outright absurd. Dowe appeals to something that is similar to many-worlds Presentism to explain that this model (i) is not absurd. "Suppose we have many worlds – many A-worlds such that whenever the now splits, each one occupies a different world... In no world is there more than one now [i.e., NOW]" (2009, 663). This model is not a *Presentist* model, but just like possible worlds Presentism it appeals to the possible worlds to make the NOW world-relative rather than now-relative.<sup>63</sup> I have argued in Chapter Two that possible worlds Presentism (or many worlds Presentism), amongst other types of A-theories, is problematic because it cannot avoid the damaging regress posed by McTaggart's Paradox. Therefore many-worlds Presentism should be rejected.

I agree with Dieks that Dowe's time-travel story is a *reductio ad absurdum* of this type of A-theoretic time-travel. Not only is this "weird", as Dowe states, but also it is problematic for the A-theorist. This is because the A-theorist holds that there is a *single* objective moving NOW. Yet on Dowe's bifurcating model (i), there are multiple NOWs.

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<sup>63</sup> See my §2.2.3 on possible worlds Presentism as a solution to McTaggart's Paradox. Now-Relativity of the NOW is the problem outlined in McTaggart's Paradox, while World-Relativity of the NOW is the possible worlds Presentism view which is a supposed solution to the Paradox.

The notion of multiple NOWs is not consistent with an A-theoretic understanding of time<sup>64</sup>, and would be best made sense of on a B-theoretic model in which the now is a mere indexical fact, and hence there can be multiple nows.

The second way we could interpret Dowe's loop model is the **Finite A-time model (ii)**. "If A-time ended when the NOW hits *b* for the second time (in A-time), that would be to say that there are future times which never have the privilege of being present" (2009, 664). On this story, then, the now bifurcates at *d*, and one of the NOW s goes forwards to *f*, while the other goes around the loop. When it reaches the merging event (or the end of the wormhole) at *b*, the NOW does not continue on through *b*, *c* and *d*, but rather, it ends, or "ceases to be" (2009, 664). Dowe holds that the problem with this model is that we have later events (the events after *b*) which are not in the future of the events that they are later than. An event being *later than the present* is part of what it means for something to be future. However, a later event *being future* of the earlier event is (part of) what it means to be later.

Perhaps we should deny that on Dowe's model the NOW bifurcates. What options are there in that scenario? Firstly, it might skip the loop altogether. Yet it is not clear what it would be for there to be a period of time, on the A-theory, that is never present (never actualized). It is not clear whether such a period exists at all if it is not ever made

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<sup>64</sup> At least, not as I have formulated the A-theory. Recently, some attempts (Maudlin 2002; Norton 2010) have been made to give an account of a 'local passage' theory, a theory which contains both the passage of time, and multiple objective moving NOWs. Even though I have rejected the notion of a hybrid A-B theory, on my account this local passage type of view would be a contender because it contains both the A-theorists' objective NOW, and the B-theorists' acceptance of multiple nows. Alternatively, one could add some third dichotomy to my two, which would allow a 'local passage' view to be able to be classified – rather than being internally inconsistent as it is on my view. Meiland also has something like a local passage or local present account where he claims, on his "two-dimensional passage [A-theoretic] model", that "we should say that Tom is living in the present while the [backwards directed] time-traveller is living in the past, even though they co-exist at one and the same moment" (Meiland 1974, 164). I take this to be an outright absurdity and hence will not discuss it further.

present. A second option, suggested by Dowe himself under model (ii), is that the NOW might go around the loop the first time, and then skip the loop the second time, such that the events in time are ordered as: *a*, *b*, *c*, *d* (bifurcation event), *e* (loop), *b* (joining event), *c*, *d* (skipping the loop), *f*. However I take it that there are two problems with such an account. The first is that it makes the mistake of assuming that there is a first and a second time for the events *b*, *c*, and *d* – as I explained earlier. On an A-theoretic view this is problematic because it implies that the NOW, which is meant to represent time itself, exists within time. Thus we return to the infinite regress of McTaggart’s paradox. Within the *B-theoretic* framework, this is analogous to the ‘second time around fallacy’ that people often make with regards to the grandfather paradox. The fallacy is to suppose that Tim’s grandfather lives the first time around, but when Tim goes back in time his grandfather may be killed. But it is not the case that there is an initial 1921 and also a revisited 1921. There is only one 1921, and in it, Tim’s grandfather either lives or he dies (Lewis 1976). The second problem with the idea that the NOW goes around the loop the first time and then skips the loop the second time, is that it appears that the NOW is following the time-traveller around in time – assuming that the time-traveller’s personal time goes: *a*, *b*, *c*, *d* (departure event), *e* (backwards time-travelling event), *b* (arrival event), *c*, *d*, *f*, and that she lives through till (and past) her earlier self’s departure event. In § 3.1 I have explained what I take to be the problem of an understanding of Presentist time-travel where the time-traveller is somehow temporally privileged with regards to the objective moving NOW, and so I will not repeat it here.

The final way that Dowe proposes that his wormhole model can be interpreted is **the A-loop model (iii)**. This is the model that he wishes to endorse.

*“When the moving now reaches b for the second time it in fact is back at the ‘first’ A-time that b was present. It does then move on through c, but this moving now is identically the same moving now as that ‘already’ passed through c. The now splits at d but fuses at c. Then there are no multiple ‘nows’ after d: the wormhole is not a now duplicator” (Dowe 2009, 665).*

The first thing worth noting here is that model (iii) no longer comes under the ‘first interpretation’ of time-travel which the first half of the chapter is focusing on. This is

because his the A-loop model attempts to be consistent by having each moment present only once, and not telling the events out of order. It does not hold that the loop, or time-travel, results in the NOW moving in an unusual way, such as back and forth in time.

However, there is a major problem with this scenario: namely that it is impossible to coherently picture. Firstly, *a* happens, then at *b* the two NOWs merge into one, then *c* happens, and then at *d* the NOW bifurcates with one NOW going on to *f* and the other NOW going back through moment *e* to merge with its earlier self at *b*. That does not initially sound problematic, but remember that the NOW which went around the loop does not simply join back with the main timeline at *b* when it gets to *b*. Instead, it joins back at *b*, *when the NOW was at b*. If one were to run a film of this event, with a dot (suppose) representing the NOW which moves across the time line, then one would have to have to separate the dot into two dots (two NOWs) at *d*, and then when dot<sup>L</sup> (the dot which took the loop) rejoined the main timeline at *b* we would see the dot<sup>NL</sup> (the dot which did *not* take the loop), ahead in time at some later moment such as *g* or *h*. However, that would imply that there was a second time which the NOW reached *b*, but Dowe has denied this. Dowe holds that there is only one A-time at which *b* was present. However, the way Dowe has told the story would require the dot<sup>NL</sup>, or the NOW, somehow be back at *b*, when it should be up at *g* or *h*, in order that the dot<sup>L</sup> which did go around the loop only joins the main timeline, and fuses with the NOW once.

There are two ways that we could attempt to make Dowe's story coherent. Firstly, we could have the bifurcation/fission event, and the fusion event, be at one and the same time, say *c*. This would allow for dot<sup>NL</sup> to pause at *c* while dot<sup>L</sup> goes around the loop and returns to fuse with dot<sup>NL</sup> and set it in motion again and continue along the time line. There may be problems with this account also, but *prima facie* it seems less

problematic than requiring some event (the fusion event) to be both earlier and later than the bifurcation event.<sup>65</sup>

Secondly, we could reject the idea that there was a world-line outside of the loop, and instead have a world in which the loop encompasses all of time – a world with circular time. Such an account would be one very similar to, if not the same as, that of Monton’s which I will discuss in §3.5. I will reject Monton’s story because it does not satisfy our requirements for time-travel. Note that Monton’s story may still be a successful account of a Presentist world with closed time-like curves – at least as successful as any Presentist account can be, given that I hold it is not a consistent metaphysical theory, as per Chapter Two). I will return to this in §3.5.

Dowe holds that this paper illustrates the problem of “the collapse of the exclusive distinction between past, present, and future” (2009, 665). However I take Dowe’s model to be another illustration of why A-theorists cannot make sense of time-travel on their understanding of time.

### ***3.3. Miller’s Objection to Open-Future Time-Travel***

In “Time-travel and the Open Future” (2005b) Miller offers a new and more sophisticated version of the Nowhere or No Destination Objection. This version focuses on the fact that causes and effects do not exist, rather than on temporal locations not existing, as per the original argument (as explained in §3.1).

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<sup>65</sup> One may object that all loops require all events to be both earlier and later than all other events in the loop, and therefore this is no more a problem for the A-theorist than it is for anyone else. However, this is not exactly true. As I will show in §3.4 and Chapter Five, the A-theorist orders events in virtue of the passage of the objective moving NOW, while the B-theorist can be reductionist about the ordering of times. It is completely coherent on a B-theoretic picture, to have the direction of time be local, and to have there be no global fact of the matter about what is earlier and what is later.

By way of objection to **Presentist time-travel**, Miller presents a case in which the supposed (backwards directed) time-traveller has come from a non-existent future location to the existent present location.<sup>66</sup> While we may grant, in response to the original no destination objection, that each end of the journey exists when the time-traveller arrives there (or departs from there), we are still faced with the bizarre consequence that “there is something very odd about the picture of cause and effect given this scenario” (Miller 2005b, 227). “The cause of that time-traveller existing at  $t$  – one of the things that makes him a genuine time-traveller – does not exist” and it is not simply the case that it does not exist *now*, but that it does not exist at all (2005b, 227). So while we may want to say that the cause of the time-traveller existing at some time  $t$  is his existence (and entrance into the time machine) at some external, later time  $t^+$ , we cannot, because  $t^+$  does not exist. The cause (or part of the cause) of the time-traveller’s existence does not exist. How bizarre.

As Miller then explains, the second objection that faces the Presentists’ account of time-travel is that if the future is genuinely open, we cannot even say that the cause of the time-traveller’s existence *will* come to be. On an open future view (as Presentism usually is, although perhaps not fully open), what we want to call the cause of the time-traveller’s existence at  $t$ , has not, and may not ever, be actualised. As Miller says, even if we grant that it is possible to travel from an existent location to a non-existent location or vice versa, it is “genuinely puzzling” how it can be possible for “a future non-existent state to cause a current event, particularly given that the nature of the future is indeterminate” (2005b, 228). This is why Miller’s argument can be seen as a causal version of the Nowhere Objection.

It is worth noting that the original No Destination or Nowhere Objection (Dowe 2000; Grey 1999) applies to the Presentist and Eternalist debate. It is relevant to whether time-travel is compatible with a view that is anti-realist about moments other than the present. The objection shows that Presentist views, as opposed to Eternalist views, are

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<sup>66</sup> The future location is non-existent because on the Presentist view any temporal location other than ‘the NOW’ is non-existent.



problematic for time-travel. Whereas Miller's sophisticated version of the Nowhere Objection seems to be more relevant to the A- and B-theory debate. This is because her version of the objection highlights that it is all A-theoretic views, not just Presentist views, which are problematic for time-travel. It is the objective moving present moment that causes problems for time-travel. In fact, the incompatibility of A-theoretic views, rather than just Presentist views, is one of the main foci of this thesis.

Miller then illustrates that the same problem is not confined merely to Presentism, but to any open future view. First she considers **the Growing Block view** in which the past does exist, but the future does not. "If  $t_5$  is the objective present, then I ought to be able to travel to all temporal locations that are in the objective past relative to  $t_5$ " (2005b, 229). However that is not the case, as Miller explains

*"If Fred [the time-traveller] exists at  $t_1$  when  $t_1$  is the objective past, then Fred must exist at  $t_1$  when  $t_1$  is the objective present. When  $t_1$  is the objective present,  $t_5$  does not exist. So it is not possible for any time-traveller to have travelled from  $t_5$  to  $t_1$ . Therefore time-travelling Fred cannot exist at  $t_1$  when  $t_1$  is the objective present, and hence he cannot exist at  $t_1$  when  $t_1$  is the objective past either"* (2005b, 229).

So the Growing Block view is subject to the same problem as the Presentist view – namely, that some event in the present is caused by some non-existent and indeterminate event. This is because on either view the time-traveller will be travelling from the present to the non-present, or from the non-present to the present, and thus the cause of his existence will not exist. Without the *cause* at  $t_5$ , for his existence at  $t_1$ , the time-traveller cannot exist at  $t_1$ , and therefore cannot travel to  $t_1$ . Not only that, but without the future  $t_5$  cause for his current existence, the time-traveller does not have the right kind of causal continuity to count as a time-traveller – his " $t_1$  person stage is not causally connected to any person stage that exists in the future, since such a stage does not exist" (Miller 2005b, 229).

Miller then goes on to show that the same problem also occurs with a **Branching Tree model** of time. On this view the trunk of a tree is analogous to the fixed past; the point at which the branches separate from the tree is analogous to the objective present; and the branches of the tree represent all the real possibilities for the future given the

present state of the universe. As the objective NOW moves forward and future possibilities are actualised, the actualised branch becomes the trunk of the tree and the un-actualised possibilities or branches drop away.

On this Branching Tree view, Miller presents a scenario in which there are two future possibilities – one in which Fred is born at  $t_2$  and becomes a backward time-traveller at  $t_5$ , the other in which Mary is born at  $t_2$  and becomes a backward time-traveller at  $t_5$ . Miller claims that on the Branching Tree view, each branch or future possibility is “ontologically real”. Given this – that both Fred and Mary “are equally ontologically real at  $t_5$  – we can suppose that when  $t_1$  is the objective present, if Fred can travel back from  $t_5$  then so too can Mary” (Miller 2005b, 230). The problem is that both branches cannot exist when  $t_5$  is the present, only one of them can. Suppose it is Fred’s branch that exists. “[W]hen  $t_5$  is the present, Fred exists at  $t_5$ , but since Mary’s branch has dropped off, she does not exist at  $t_5$ . So when  $t_5$  is the present, there exists no Mary person-stage at  $t_5$  to cause the Mary stage at  $t_1$ ” (Miller 2005b, 230). Thus there could be no Mary person-stage at  $t_1$ . And *voilà*, the same problem appears again.<sup>67</sup>

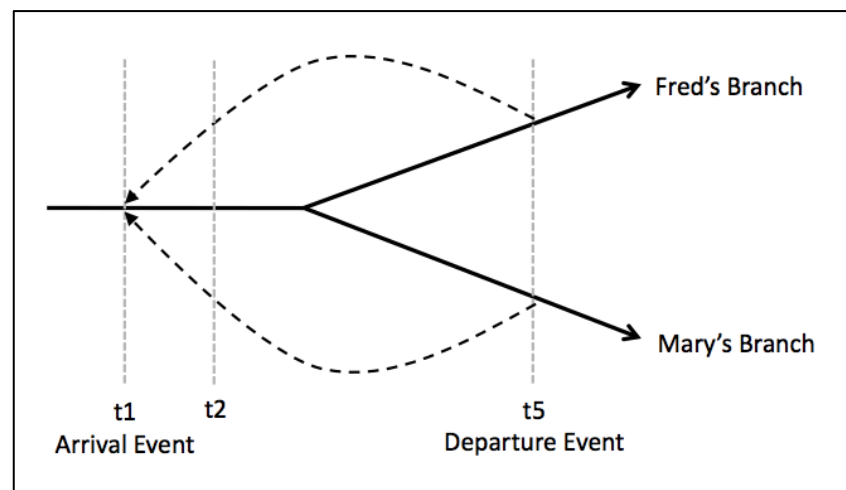


Figure 8. Fred and Mary in Branching Time

<sup>67</sup> Here we are assuming that there can be some kind of transworld identity, or possible world counterpart, between  $t_5$  in Fred’s branch and  $t_5$  in Mary’s branch.

We might be tempted to respond to the problem Miller has raised by claiming that Fred and Mary cannot both exist at  $t_1$ , and that if Fred exists at  $t_1$  then it is his branch that will be actualised at his birth and not Mary's at  $t_2$ . However, we are discussing the Branching Tree model as one in which there is a genuine open or indeterminate future. As such, we *cannot* therefore claim that due to Fred's existence at  $t_1$  that his branch *will* be actualised at  $t_2$  and that he *will* become a time-traveller at  $t_5$ . It is not the case in any sense that Fred's existence at  $t_1$  causes or ensures his being a time-traveller at  $t_5$ . In fact, we know that the causal relation is around the other way – his getting into a time machine at  $t_5$  is what causes his getting out of it at  $t_1$ . So on the Branching Tree view we are forced to say that at  $t_1$  there is no fact of the matter about which person, Fred or Mary, is a time-traveller. But once  $t_5$  is the present it will *become* true that at  $t_1$  it *was* true that Fred *was* a genuine time-traveller at  $t_1$ . However, we know that when  $t_1$  was the present there was no fact of the matter. But *was* Fred or was he *not* a time-traveller at  $t_1$ ? This scenario about the truth of Fred's being a time-traveller seems to either require us to accept that the past has been changed or that we must accept contradictions.<sup>68</sup> Miller, too, concludes that on the Branching Tree view we would have to accept a contradiction, that the past has been changed, or, we need to say that Mary is not a genuine time-traveller. Miller explains

*“If we think that when you remove the cause you remove the effect, then we will conclude that Mary exists at  $t_1$  when  $t_1$  is the present – since the cause exists at  $t_5$  – but does not exist at  $t_1$  when  $t_5$  is the present – since the cause does not exist at  $t_5$ . Then ... the past has changed”* (Miller 2005b, 230).

### 3.3.1. Martinez's Reply to Miller

Martinez (2011) holds that he has a reply to Miller's argument against the Branching Tree view, but claims that Miller must ignore such a reply due to an assumption she has about admissible evolutions of Branching Trees. Martinez claims that Miller is not

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<sup>68</sup> It is widely accepted that it is impossible to change the past, as that would involve a logical contradiction. This has been discussed in my §1.13 where I argue against the possibility of changing the past, specifically with reference to an argument given by Vranas (2005).

really forced to accept that both Fred and Mary could travel to the present time, as her argument says. Martinez charges that

*“Miller is trading on an ambiguity between:*

*1. (It is possible that Mary travels to the past) and (it is possible that Fred travels to the past)*

*2. It is possible that (Mary travels to the past and Fred travels to the past)”*

(Martinez 2011, §3).

He points out also that this is analogous to a reply that Belnap and Green (1994) give to the problem of branching time: It is not the case that there will both *be* and *not be* a sea battle tomorrow, rather it is the case that either there will be a sea battle or there will not.

This seems like a convincing response to Miller; however, we soon see the mistake that Martinez is making. Martinez goes on to claim that

*“Fred's and Mary's going back in time are in mutually incompatible branches, and this means that, e.g., Mary travelling settles that Fred does not travel and vice versa. Otherwise put: if the situation is one in which Fred is roaming about in  $t_1$ , this means that the event which causes his presence in  $t_1$  – that is, his entering the time machine in  $t_5$  – will happen”* (Martinez 2011, §3).

Martinez also holds that the mistake Miller is making is that she is using standard tree pruning when she should be using non-standard tree pruning. By ‘tree pruning’ he means the way in which branches are removed from the tree of time as a result of the passage of time. The assumption that Martinez thinks Miller is unwarranted in holding is that she can use standard tree pruning. Martinez claims that standard tree pruning is acceptable only in worlds with standard causation – for example, in the absence of backwards causation. He claims that the “tree evolves as it does because the events happening at a certain moment cause the events happening at the next moment” (Martinez 2011, §4).

Suppose we agree with Martinez about the tree pruning, his reply to Miller is still mistaken. This is so because, **firstly**, his claim that Mary’s travelling settles that Fred does not and vice versa, is precisely the claim that Miller and I have anticipated and

rejected in my §3.3 just above. While we agree with Martinez that it cannot both be the case that Fred and Mary exist in the future, we do not agree that Mary's existence in the present can ensure that she comes into existence in the future, and not Fred. This is ensured by the fact that we are telling an open future story. If Martinez wants to say that it is possible on a Branching Tree view for the future to still be genuinely open, yet at the same time claim that some event in the present (such as at the arrival event  $t_1$ ) can determine some event in the future (such as the departure event at  $t_5$ ) then he must provide an argument for it. This is because it is not at all clear how some future event can be determined whilst we still claim that the future is fully and genuinely open. Thus we have the problem that, at  $t_1$ , it is not determined whether Fred or Mary will come to exist at  $t_2$  and become a time-traveller at  $t_5$ . Consequently we arrive again at Miller's original conclusion with two alternatives. Either (i) neither Fred nor Mary can be time-travellers at  $t_1$  since the cause of their being time-travellers – namely their coming into being at  $t_2$  and departure event at  $t_5$  – does not, and may not ever, exist (under the assumption of an open future). And thus we do not have a Branching Tree time-travel story. Or (ii) both Fred and Mary exist and are both time-travellers. However, we cannot accept (ii) because it leads to a contradiction since it is not possible that both Fred and Mary are time-travellers (as held by both Miller and Martinez). Therefore, since the Branching Tree account of time-travel entails a contradiction. Therefore we must reject time-travel on a Branching Tree account – at least on an account with an open future, as set out by Miller.

**Secondly**, Miller's Branching tree account does *not* use backwards causation, and therefore Martinez cannot say that she is employing the wrong tree pruning method for cases of backwards causation. The reason that Miller's story does not employ backwards causation is because one of the key features of Miller's time-travel story is that the future cause of the arrival event (such as the future departure event) does not yet, and may not ever, exist. This is precisely why Miller's objection is considered a more sophisticated, or *causal*, version of the nowhere argument; because, rather than some time not existing, on Miller's story it is parts of the causal chain that do not exist. If Martinez hopes to show that Miller is using the wrong type of tree pruning for a story with backwards causation, then he first needs to show that her story is even using

backwards causation. If Martinez wants to argue that Miller's story does involve backwards causation he will have to give an account of how some non-existent future event can cause some present event, before he can begin to show that it is a story with backwards causation. Furthermore, I will argue in §3.4 that given the way A-theoretic views (such as Branching Tree views) order time, such views cannot possibly employ backwards causation. Thus I hold that there can be no time-travel on A-theoretic views, because the causal ordering cannot come apart from the temporal ordering.

### **3.4. Keller and Nelson's Presentist Time-Travel**

Keller and Nelson have given an account of time-travel in a Lewisian sense,<sup>69</sup> yet using the language of Presentists. They claim that the apparent conflict between Presentism and time-travel is due to the fact that time-travel stories are nearly always told within a four-dimensional framework. They claim that "all the details that featured in the four-dimensionalist story can be included in the Presentist story too, so long as they are expressed as tensed truths properly relativised to the present" (2001, 338).

It is worth noting that it is not entirely clear if by four-dimensionalism Keller and Nelson mean to refer to Eternalism (which is realist about all moments of time), the B-theory (which is Eternalist *and* anti-realist about the objective moving present), or Perdurantism (which holds that entities have temporal parts).<sup>70</sup> I will assume that they mean to refer to Eternalism and they are engaging in the Presentist vs. Eternalist debate, as applied to time-travel. Not only will I be replying to the arguments Keller and Nelson give in favour of Presentist time-travel, my discussion will also serve to reiterate my view that it is not just Presentism that is incompatible with time-travel, but all A-theoretic views. I will show that the A- vs. B-theory debate is just as pertinent to time-travel than the Presentist and Eternalist debate, if not more so. In reply to defenders of A-theoretic time-travel I will show two things. Firstly, I will show that the A-theorists are wrong about the what the B-theorist time-traveller is doing – in fact the B-theorist can,

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<sup>69</sup> A discrepancy between personal- and external-time, as set out by Lewis in his 1976 paper.

<sup>70</sup> See Chapter Two for an in depth discussion of classification and definition of these views.

and should, be doing something more with their time-travel account. The B-theorist can tell a type of time-travel story (although some B-theorists will not) that the Presentist can never tell. In particular, the type of paradigm time-travel case from Chapter One. Secondly, I will show that even if B-theoretic time-travel is what the A-theorists claim it to be, the A-theorists do not have the metaphysical machinery to tell such a story.

Keller and Nelson tell a time-travel story that they suppose is compatible with Presentism. In it, an unmotivated teenager, Jennifer, is listening to music at home when an old woman appears as if from nowhere, chats with her and convinces her to start playing tennis, and then disappears again. Teenage Jennifer therefore starts training and becomes a tennis champion, she has a long, successful career, and retires as an old woman. They also tell a story in which, one night while elderly Jennifer is at home, a nutty professor appears and gives Jennifer a time-travel device. Elderly Jennifer decides that she wishes she could travel back in time and stop her younger self from having such a depressing youth. So she uses the time-travel device, finds herself in the bedroom of her teenage self, and gives her teenage self a tennis pep-talk. After an hour of that, elderly Jennifer uses the time-travel device again and returns to her own time to find that the clock on her mantle piece shows approximately the same time as when she left, yet her wristwatch shows that she has been gone an hour (2001, 335-6). These two stories are really one and the same time-travel story. One is told by tracking young Jennifer, and the other, tracking elderly Jennifer.

Here is how Keller and Nelson tell Jennifer's time-travel story on a Presentist picture:

*"Suppose that Presentism is true; the only things that exist are the things that exist right now. Still, there are plenty of past- and future-tense truths. Here are some of them. There is a woman named 'Jennifer' who is preparing to compete at Wimbledon. Jennifer was a glum, unhappy fourteen year old. In 1985, an old woman named 'Jennifer' suddenly appeared in Jennifer's bedroom, staying for an hour before disappearing again. Jennifer will win Wimbledon, and eventually she will enter a happy retirement. After a visit from a nutty professor, she will disappear in 2054, and then she will reappear with memories of having just spent an hour in a black bedroom talking to her teenage self. When she*

*reappears, her watch will say that it is ten o'clock, even though the clock in the room will say that it is nine"* (Keller and Nelson 2001, 338).

Keller and Nelson claim that what is needed to make Presentism compatible with time-travel is for the time-travel story to be told – with all the same events at all the same times – in the Presentists' present tensed language, as they have done above. They claim that while Presentists hold that past and future times do not exist, most Presentists still believe that there can be such things as past and future tensed truths, i.e., that there can be facts about the past and the future. Because of this, Keller and Nelson hold that

*"the Presentist can have just the same patterns of events happening at just the same times [as the Eternalist, B-theorist]. Or at least, it can be the case on the Presentist model that the right sorts of events will happen, or did happen, or are happening, at the right sorts of times. If it suffices for four-dimensionalist time-travel that Jennifer disappears in 2054 and appears in 1985 with the right sorts of memories, then why shouldn't it suffice for Presentist time-travel that Jennifer will disappear in 2054, and that she did appear in 1985 with the right sorts of memories?"* (Keller and Nelson 2001, 338).

If it is true that all we need for a time-travel story is for the right sort of events to happen at the right times, and the right sort of memories to be present, then we can say that the Presentist has succeeded in showing that Presentism and time-travel are compatible. And they have done so by merely showing one can tell a time-travel story in the Presentists' present tensed terms. But I do not think that this is all that is required for a time-travel story.

It might be said that Keller and Nelson have not succeeded in giving an account of time-travel in the Presentists' language. I will not discuss whether this is the case or not. What I will argue instead, is that there is more to a time-travel story than just being told in a certain way (as per Keller and Nelson), and more than having the events causally connected in the right way (as per Daniels, 2012) – if the Presentist can even have the events causally connected in such a way. I will show that even if having the events causally connected in the right way was enough (which I do not think it is), the Presentist cannot have the events causally connected in such a way, due to the way that Presentists (and all A-theorists) order times and events. That ordering results in an



inability for the causal ordering to come apart from the temporal ordering, which is required for genuine time-travel, as set out in Chapter One.

### **3.4.1. Sider's Objection to Presentist Time-Travel**

Sider argues against Keller and Nelson claiming that the Presentist cannot make use of Lewis' distinction between personal and external time because they do not employ a 'spatialised' (B-theoretic) account of time. Sider holds that without personal time the Presentist story is not one of time-travel. It is worth noting that Sider talks in terms of A- and B-theories. I believe that by this he means to refer to the views I have called Presentism and Eternalism, but he also sometimes makes claims that obviously refer to the A- and B-theories as I have defined them. Avoiding this ambiguity is one reason to adopt my classification system as set out in Chapter Two.

Sider believes that Lewis' personal and external time only can only be applied if one is employing a spatialised account of time. This is because, he states, that what orders the time sequences in each case – on the A-theory or the B-theory – is very different. In a B-theoretic picture, what grounds the order of moments in time will be some temporal asymmetry such as causation or entropy. However on an A-theoretic view – such as Presentism – what orders time sequences is the objective moving NOW. Because the objective moving NOW does not follow the time-traveller going back in time as he does, on a Presentist picture the events cannot be legitimately ordered in the way they would be in personal time, properly understood. Therefore, Sider charges that on a *Presentist* view, “personal time does *not* ‘play the role that time plays in the life of a common person’” (Sider 2005, 332). He also holds that a Presentist who is about to get into his time machine cannot truly say “in two minutes I will gaze upon a dinosaur” because “if personal time bears little similarity to external time then ‘personal time’ is merely an invented quality, and is misleadingly named at that” (Sider 2005, 333). On the Presentist picture, “it is not true that I am *about to* see a dinosaur ... The [time machine] causes it to be the case that I once viewed a dinosaur, but does not make it the case in any real sense that I *will* view dinosaurs” (Sider 2005, 333).

Sider concludes that “the conflict between time-travel and Presentism thus does not issue directly from Presentism itself, but rather from the usual Presentist conception of the tense operators” (Sider 2005, 334). I will not discuss the proposed alternative tense operators because as I have already argued (in section 3.1), I think the culprit is the moving NOW, which is the defining feature of A-theoretic views. I also think that Sider’s position and reasons against Presentist time-travel (specifically his claims about what grounds the ordering of events) are compatible with my reasons given against Presentist time-travel (the objective moving NOW is the problematic feature of accounts of Presentist and all A-theoretic time-travel).

### 3.4.2. Daniels’ Defence of Keller and Nelson

Daniels claims that “whether someone is a time-traveler depends on how her life is causally describable” (2012, 479). Specifically, if the person stages exist at the right times, have the right causal relations between one another, and the arrival event is causally later than the departure event, then the person – Jennifer in this case – is a time-traveller. He holds that Sider has placed too much emphasis on the issue of tense.<sup>71</sup> According to Daniels, so long as the Presentist can adopt a *causal account* of personal identity, then time-traveller Jennifer will not cease to exist after she gets into the time machine, as Sider has objected, but instead she will *subjectively* survive her time-travel journey to the Mesozoic era.

Daniels holds the order of external time for the Presentist to be determined by the passage and direction of the moving NOW, but he also holds that *personal time* is to be understood as what will subjectively happen to someone given the causal ordering of

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<sup>71</sup> Sider points out that for the Presentist the “external future consists of facts expressible with future-tense operators”, that the direction of time “is a matter of the difference between the *sui generis* past tense operators and the *sui generis* future tense operators”, and that the Presentist time-traveller’s personal future “concerns a network of past-tense causal statements” which is “quite different from the nature of [her] external future, which does not concern causation at all, and which concerns *future-tensed* statements”.

her person stages. Daniels holds that this is consistent with Sider's understanding of personal time. I think it is not.

Daniels claims that normally when we talk of what will subjectively happen to someone “we are either talking about what is going to happen to her in future temporal locations [as per external time] or what is causally downstream for her” as per personal time (2012, 480). In a regular person's life these two do not come apart, but for the time-traveller, Jennifer, we are only concerned with what is causally downstream for her person stages (2012, 480).

Daniels claims that so long as the Presentist has a sufficiently robust account of past and future facts (or truths) – as per Bigelow, for example – then the Presentist can ensure Jennifer did exist in the Mesozoic era because the Jennifer-like person existing in the Mesozoic era is suitably causally continuous with the person, Jennifer, who enters the time machine in the modern era. The modern era person-stages of Jennifer have the right causal connections to the Jennifer-ish person-stages in the Mesozoic era – meaning that a single person, Jennifer, spends time in both eras. Daniels holds, therefore, that the Presentist can do, what the B-theorist can do, with regards to time-travel.

### **3.4.3. *Preliminaries to my Reply to Daniels***

Before I say why I think that Daniels' Presentist time-traveller is not doing (or able to do) what the B-theorists' time-traveller is doing, I want to say what I think is going on for the B-theorists' time-traveller. The view I will defend here is not just one that A-theorists cannot accept, it is one that many B-theorists may not accept. If my account of time-travel is not what a certain type of B-theorist holds time-travel to be, then I will explain that it is what they *should* hold time-travel to be, if they are serious about time-travel.

Sider has said that a crucial feature of a time-travel story is personal time playing the role of normal (external) time. I take this to be because for the backwards time-traveller it is not the case that it seems to them that they are going backwards in time when we

consider how *they* experience time's contents, or the content asymmetries, such as the asymmetries of causation, entropy, knowledge, action and so on. For the time-traveller, their experience of the events inside their time machine during the time-travel event will be on par with their experience of events and temporal asymmetries in normal, non-time-travelling life.

It is important to note here that this is not a matter of *experience* alone. While it is true that these asymmetries are experienced by, or happen to, the time-traveller, they are also *objective facts* about events going on in the time machine and they would be so even if Jennifer did not experience them (if she was asleep or unconscious), or if our time-traveller was not a conscious or sentient creature at all, but rather a pot plant or a mug of coffee. The events within the time machine are objective facts, not mere experiences, because we want Jennifer's being-a-time-traveller to be an *objective* fact, not something that is simply relative to her subjective experiences. This is even more so the case if we employ the 'strong' notion of time-travel as set out in Chapter One.

However, Lewis has said personal time is "not really time" but that it "plays the role" that (external) time plays in the life of the non-time-traveller (1976, 146). So what exactly is personal time then, and how can it play the role of time if it is not? I hold that personal time should be understood as more than just a mere rhetorical device or "invented quality";<sup>72</sup> as more than just a way of telling of the story. This is because we want time-travel to be an objective fact, not a subjective one. We want it to be the case in some genuine and objective sense that Jennifer will view dinosaurs after her departure event. It is not simply that we tell a story of some events in a certain way and then we have a time-travel story. If Jennifer does not really travel anywhere after her departure event then we cannot say that she is a time-traveller.<sup>73</sup>

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<sup>72</sup> "If personal time bears little similarity to external time then 'personal time' is merely an invented quality, and a misleadingly named one at that" (Sider 2005, 333).

<sup>73</sup> I am assuming here that we are adopting the account of time-travel that I gave in Chapter One and that we are realists about the notion of time-travel. Realist being understood in a loose sense, in which the existence of the thing in question is not subjective, mind dependent or interpretation dependent.

I hold, therefore, that for there to be an objective fact about Jennifer's being-a-time-traveller, we should take personal time to be local time.<sup>74</sup> On a B-theoretic view which is reductionist about the direction of time, when causation, entropy, knowledge and so on, go backwards, as they do in a backwards time-travel story, time can be said to go backwards too. This is a consequence of views that reduce the direction of time to the direction of some content asymmetry or asymmetries.

When personal time is understood to be a region of local time, the time-travel story no longer involves the problematic element causation at a temporal distance, which is often used to reject the possibility of time-travel.<sup>75</sup> This is because during her trip back to the Mesozoic era, time and causation go in the same direction as the asymmetries experienced by (or happening to) the time-traveller. Consequently, there is no causal or temporal break in her world line. Given that her world line is continuous (and that she does not die in transit or suffer brain death) then we can also coherently claim that Jennifer survives the entire trip (in the full-blown sense of personal survival) in the same way that we would for (successful) non-time-travellers.

Taking personal time to be local time need not threaten a notion of there being a fundamental objective direction of time.<sup>76</sup> This is because personal time, and the space-time region the time-traveller is travelling in, can be understood as an area of space-time with a local direction of time that is different from the direction of time in areas that are not containing current time-travellers.

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<sup>74</sup> By local time I just mean that time, its direction, and speed, and asymmetries in its topology, are relative to certain regions of space-time. The isolated and encapsulated region from Chapter One can be understood to be a region of local time.

<sup>75</sup> Like Keller and Nelson (2001, 340) I think that the Presentists' account necessarily involves causation at a temporal distance, but I hold therefore that it should be rejected. I will expand on this idea in the following section.

<sup>76</sup> However, I do not endorse the notion of a fundamental objective direction of time, and I will return to this issue in Chapter Four.

There are hints of this in Sider, for example, his focus on the importance of Presentism's anti-reductionism about the direction of time, and when he claims that "[t]ime-travelers are local currents" in time. However Sider does not go quite as far as I do, which is to focus on the role of the direction of time, and to claim that personal time (in the case of the time-traveller) should be understood as local time (local time when contrasted with the non-time-travelling region that the time-traveller left from or arrived at).

#### ***3.4.4. Objection to Daniels, and Why The Presentist Cannot Time-travel***

For the Presentist, and other A-theorists, the direction of time is determined by the direction of the single, objective, moving NOW. The Presentist does not have the option of ordering time and/or time's contents (content asymmetries such as causation, entropy, and so on) separately from how the objective moving NOW orders moments of time. On the Presentist picture, the only way that time and time's contents can be ordered is as per the single, objective, moving NOW.

But Keller and Nelson have anticipated such a reply. They have said that it might be objected that "[c]ausation ... must take place with the Presentist NOW and so causal relations can only hold between events that follow one after the other" (2001, 340), but they hold that such a charge is mistaken because causation is a relation, not an event. While this is true, it is still the case on the Presentist picture that all events – including causes and effects, of course – must happen within the present moment. I do not mean by this to suggest that both the cause and the effect are simultaneous with each other. Rather that all events happen when it is the present; events can happen in the past, but only when that past moment was present. Events do not happen when they are not present. Events do not *now* happen at moments in the past or in the future. Given that events cannot *now* happen in the past or the future, it follows that the ordering of the causal chain must therefore follow the ordering of the objective moving NOW.

But why do we need it to be the case that there is a genuine causal or temporal ordering that constitutes personal time? The answer is that without it we can only say that her

getting into the time machine *caused* it to be the case that she *did* view dinosaurs. We cannot say that when Jennifer gets into the time machine she *will* view dinosaurs, and we cannot say that the arrival event in the Mesozoic era becomes present after the departure event.

However, if what the Presentist is saying is that it is not the case that Jennifer goes back to Mesozoic era *after* she gets into her time machine, but rather, “because I am [or she is] entering the time machine, it was the case two hundred million years ago that I am [or she is] viewing a dinosaur” (Sider 2005), then we must conclude, given my exposition of time-travel in §3.4.3 and Chapter One, that she is not a time-traveller. Interestingly, it seems that Sider, Daniels, and Keller and Nelson all agree, to some extent, that Jennifer does not really go anywhere. Sider says “Suppose that my dinosaur viewing is in no sense located two minutes in my future. Then it seems wrong to say that I *travel* in time. What is true instead is that I once viewed a dinosaur” (2005, 330). But the same is said by Daniels and by Keller and Nelson who argue *for* the compatibility of Presentism and time-travel. Daniels says “[t]he way Sider explains the Presentist ability to parse time travel talk is right – Jennifer, literally, is not someone who exists anywhere after her departure time; she, literally, does not go anywhere” (2012, 482). Keller and Nelson ask “Should we then say that the Presentist does not really believe in the possibility of time-travel, but only in the possibility of odd arrangements of past and future-tensed truths? Perhaps we should” (2001, 345).

### **3.4.5. Why Solutions to My Objection Fail**

There are three solutions that the Presentist might employ to make backwards time-travel compatible with their single, objective, moving NOW, given that they face the problem that on their account the arrival event does not in any sense happen after the departure event. However I will show that none of these solutions are viable options.

**Firstly**, the Presentist could give an account of how (the direction of) causation or time's contents can come apart from the direction of time given by the direction of the NOW. This would allow them to say that the arrival event was *causally* (although not

temporally) later than the departure event. This is the claim that Daniels makes about the Presentist time-travel story.

In order to do this, the Presentist would need to sever the relationship between the direction of time and the NOW from the direction of the content asymmetries. They would need to do this in order that the asymmetries of causation, entropy, knowledge, and so on, act in the opposite direction from time. Not only do I think the Presentist cannot sever this relationship (I will explain why in the following paragraphs), but I take it this is not something the A-theorist (or even B-theorists) would *want* to do. But without severing that relationship, the Presentist lacks an account of how the departure event can cause the arrival event, given that they are temporally and therefore causally separated (the B-theorist does not lack such an account). This leads us on to the second solution.

**Secondly**, the Presentist could give an account of causation at a temporal distance. Keller and Nelson have claimed that “the time travel stories that we claim to be compatible with Presentism ... involve causation at a temporal distance” (2001, 340). But causation at a temporal distance is often raised as an objection at time-travel in general and it is often said therefore that this is no more problematic for a Presentist than it is for B-theorist (Keller and Nelson 2001; Daniels 2012). However, I take this to be mistaken. Firstly, causation at temporal distance is easier to account for on Eternalist views (such as the B-theory, the Growing Block, and the Moving Spotlight<sup>77</sup>) in which moments other than the present really exist. This allows us to avoid the problems raised by Miller in “Time Travel and the Open Future” (2005b) in which she presents a more sophisticated, causal version of ‘the nowhere argument’.

Furthermore, I have explained in the previous section that the B-theorist does not in fact need to rely on causation at a temporal distance in their time-travel story. This is

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<sup>77</sup> Sider argues otherwise. He thinks that the Growing Block and Moving Spotlight views are more problematic than Presentism, but is focusing on different features than those I am focusing on, to come to that conclusion.



because the B-theorist can understand personal time as local time in which eddies of time, causation, entropy, and other content asymmetries go ‘backwards’ *with* the time-traveller. This means that there is no temporal distance and therefore no causal jump between the departure and the arrival event, since the causal chain is contiguous. Thus, I take causation at a temporal distance to be a problem only for the A-theorists, perhaps more so particularly for the Presentist. Without an account of how causation at a temporal distance is possible, time-travel which involves causation at a temporal distance – as the Presentists’ does – is problematic, to say the least.

It is not clear what kind of story the Presentist (or other A-theorists) can tell about the causal connection between the departure and arrival events. The Presentist (and other A-theorists) seem to be lacking an account of what Cartwright (2007) calls ‘thick’ causation, in their time travel stories. The Presentist can say that there is a causal relation between the departure and arrival events, and the temporal parts at those events. But this is causation in Cartwright’s sense of ‘thin’ causation. When pressed for more on what that causation is and how it works, what Cartwright calls a ‘thick’ account of causation, they have not given any answer – indeed, I believe that they *cannot*.

**Thirdly**, the Presentist could say that the objective moving NOW follows the time-traveller around. From this it would follow that as the time-traveller goes back in time, so too does the NOW – the time-traveller takes the present with her, as it were. So instead of claiming that it was the case that when she left the 2000s it caused it to be the case that she once viewed dinosaurs, on this possibility we understand it to be the case that, after the time-traveller leaves the 2000s, the Mesozoic era is then present. This would be a bizarre world in which the time-traveller is somehow temporally privileged.

There are a number of problems associated with this:

(a) The people and events in the time period that Jennifer left from (at the departure event) *were* in the present, but *then* came to be in the future (since the NOW went into the past with Jennifer). It is normally said by A-theorists that an event goes from being future to present to past. But in this story the departure event goes from

being future, to present, and then to future again (once Jennifer is in the Mesozoic era and the objective NOW is there with her). This is problematic for the Presentist because it will confuse their method of defining past and future and the temporal directions of earlier and later, since this is done in virtue of the passage of the NOW.

(b) Once Jennifer goes back in time and the NOW goes with her, the departure event has not happened yet; it is in the future. Additionally, if we take Presentism to be an open future view then it cannot be said that Jennifer is a time-traveller (as objected by Miller) because the departure event has not, and may not ever, happen.

(c) We could run into a problem where the causal and/or temporal loop<sup>78</sup> which is Jennifer's backwards traveling event, becomes a 'NOW generator', as set up by Dowe in "Every Now And Then" (2009), and as discussed in §3.2. In Dowe's time-travel story, every time the NOW reaches the departure event it branches or splits, one NOW goes back in time with the time-traveller, while another goes forward in time as we normally think of the NOW as doing. This would require the Presentist to give up on the notion of a *single*, objective now.

However, I do not take it that it is logically *impossible* that there be worlds where the single objective moving NOW does follow our time-traveller Jennifer around and that Jennifer is temporally privileged in that sense. I merely claim that this is not a picture the (actual world) Presentists would want to endorse, and thus we should reject it.

Sider claims that "Presentism's anti-reductionism about the direction of time ... is what renders Presentist external time dissimilar from Presentist personal time" (2005, 332). On the Presentist picture, the only way that events can be ordered (and perhaps also directed) is in the order that they 'come into being' as per the movement of the objective NOW. On the Presentist picture it is the moving NOW which generates a temporal order and/or temporal direction. Unless 'the NOW' jumps around all over

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<sup>78</sup> Perhaps understood as loop of light cones, since we are talking about time-travel in a world with a background space-time, as specified by Keller and Nelson.

time (either randomly, or with the time-traveller<sup>79</sup>) then the only way that events can be ordered, on a Presentist (or any A-theoretic) picture, is the way that they are ordered in external time. But because the B-theorist can be a reductionist about temporal order and/or temporal direction, the B-theorist can order events in virtue of the order or direction of causation, entropy, cosmological expansion, radiation, and so on. So suppose the B-theorist reduces temporal order to causal order, and suppose the time-traveller goes backward in time (with regards to external time) and that causation *goes with* the time-traveller – so his getting into the time machine at t5 causes his exiting the time machine at t1 – then we can genuinely order the events as they are in his personal time.<sup>80</sup> By ‘genuinely’ I mean that the ordering is not artificial or arbitrary; the events really are ordered that way according to causation, or a causal chain. Interestingly, Daniels admits that the only real sense in which something will happen, for the Presentist, is if it is “forthcoming in the passage of time” (2012, 479), and that “[t]he way Sider explains the Presentist ability to parse time travel talk is right – Jennifer, literally, is not someone who exists after her departure time; she literally, does not go anywhere” (2012, 482). But Daniels claims that “that is not what is important since the Presentist has a relevant sense that we *do* care about in which Jennifer will view dinosaurs...” (2012, 482) namely that the causal connections exist between her departure and her arrival event.

However, I have shown that not only is this *not* what is relevant when assessing whether Jennifer is a time-traveller. I have also shown that even if it was, those causal connections cannot exist on a Presentist picture, without employing the problematic notion of causation at a temporal distance. Thus the Presentist cannot give an account of time-travel (at least ‘strong’ time-travel) that is consistent with their ontological commitments. If I am wrong about what personal time and time-travel is on the B-theorist’s account, then I take it that my objections to Daniels’ Presentist’s time-travel

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<sup>79</sup> And, as I have argued at the beginning of this chapter, we are not justified in thinking that the time-traveller is somehow special and that ‘the NOW’ follows him or her around in time.

<sup>80</sup> I will discuss this further in the following two chapters. In Chapter 4 I will discuss the causal theory of time, and in Chapter Five I will apply the causal theory to time-travel.

will equally apply to many cases of B-theoretic time-travel too. By this I mean that I take it that the objections I have raised apply to *some* B-theoretic time-travel stories too. However I have shown that there is a more robust account of time-travel that is available to the B-theorist, and not to the A-theorist.

#### **3.4.6. Some Further Considerations of Keller and Nelson**

There are also a number of other problems with Keller and Nelson's account of Presentist time-travel that either need to be discussed further, or have not been touched on by Sider nor Miller. I will address these here. Keller and Nelson claim that:

*"If it suffices for four-dimensionalist time-travel that Jennifer disappears in 2054 and appears in 1985 with the right sorts of memories, then why shouldn't it suffice for Presentist time-travel that Jennifer will disappear in 2054, and that she did appear in 1985 with the right sorts of memories?"* (Keller and Nelson 2001, 338).

However, the antecedent of this claim is false. As I have already explained, I do not believe it suffices on any conception of time-travel. On the A-theoretic, Eternalist picture there can be no time-travel – as I have spent this chapter arguing. On the B-theoretic, Eternalist view it also does not suffice that Jennifer merely appear and disappear at the right times, and that she have certain memories. That is *not* what would make Keller and Nelson's Jennifer a time-traveller. On the B-theoretic view, if we appeal to the personal time of the time-traveller and we order the events accordingly then there *can* be a true sense in which part of 1985 happens just minutes after 2054. If the time-traveller goes back in time via a traversable worm hole or semi-closed time-like curve, or some kind of isolation and encapsulation mechanism (as set out in §1.10), then there is a *real* sense in which the events happen to the time-traveller in the order that the time-traveller thinks that they happened (2<sup>nd</sup> of May 2054, 3<sup>rd</sup> May 2054, 16<sup>th</sup> August 1985, 4<sup>th</sup> May 2054, and so on). The B-theorist can order the events that happen in the time-traveller's personal time by appeal to the direction and ordering of causation or entropy (as I have explained in §3.4.3 and will discuss further in Chapter Five) yet the Presentist cannot. In §2.1 I explained that the A- and the B-series are not different series, they are different ways of ordering the same series, or, that the A- and the B-series place the same events in the same order, despite using different properties

(A-properties or B-properties) to ground the ordering of those events. However, as we can now see, this fact about ordering is not true in all cases. It is not true in cases that I count as instances of *genuine* time-travel, as set out in Chapter One and again in §3.4.3, above. In time-travel cases the ordering given by the A- and the B-theorists comes apart. Because the A-theorists must order events due to their A-properties, which are generated in virtue of the objective moving NOW, they do not have the option to order the events as the B-theorist can. Thus, the A-theorists are unable to account for genuine time-travellers on their A-theoretic picture.

A similar response to the one above (one which appeals to temporal ordering) can be given with regards to the Presentists' requirement of causation at a temporal distance. Keller and Nelson claim that

*"Time-travel stories – or at least, the time-travel stories that we claim to be compatible with Presentism – involve causation at a temporal distance. We have causation at a temporal distance when the occurrence of an event at one time causes the occurrence of an event at some distant time, and there is no chain of causal dependence that links the two events across time. If personal identity across time requires relations of causation, then our story obviously involves causation at a temporal distance. But even if some other account of personal identity is the right one, it seems clear that some sort of odd causation will have to be a part of a time-traveler's life"* (Keller and Nelson 2001, 340).

Firstly, Keller and Nelson have said "there is no chain of causal dependence that links the two events across time". However, Daniels (2012) would claim that there is, in his attempt to defend Presentist time-travel. But, I have argued in §3.4.3 why this is not so.

Secondly, Keller and Nelson go on to briefly present three objections against causation at a temporal distance: the claim that backward causation is ruled out a-priori, the grandfather paradox, and the time-traveller not having causal continuity and therefore not having personal identity and persistence across time. But they claim that "each of these ways of arguing against the possibility of causation at a temporal distance, however, would show that our time-travel story is impossible simpliciter; not that it is merely incompatible with Presentism" (2001, 340), and that there is not "an argument

against the possibility of causation at a temporal distance which is particularly targeted at the Presentist..." (2001, 340).

Yet this last claim, that there is no argument particularly targeted at the Presentist, is false. By appealing to personal time the B-theorist has a way of avoiding causation at a temporal distance, in her time-travel story. Personal time, which is not available to the Presentist, allows there to be a contiguous causal chain between the arrival and departure events which means that causation is not truly at a temporal distance (because the B-theorists can have this temporally contiguous causal chain that links the departure and arrival events). This therefore allows the time-traveller to have personal identity with his earlier and later parts.

Keller and Nelson then anticipate an objection that might be raised against Presentist causation at a temporal distance:

*"Presentists believe that temporal becoming, or the flow of time, is an objective feature of the world. One might claim, then, that causation must keep pace with the moving now. Causation, it might be said, must take place within the Presentist now, and so causal relations can only hold between events that follow one after the other ... But causation is not an event, it is a relation between events, and relations between events are not the sorts of things that happen at a time"* (Keller and Nelson 2001, 431).

Here they are claiming that it might be objected that on the Presentist view causation must take place within the moving NOW. They hold that this charge is mistaken because causation is a *relation* between events, and not an event itself, and the Presentist can still have relations between existing and non-existing events or times. I reply that while causation itself is a relation, on a Presentist picture, any event (such as a cause or an effect) must happen within the present moment,<sup>81</sup> because events cannot happen in the past or the future (since such times do not exist). Therefore the ordering of a causal

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<sup>81</sup> I do not mean to imply that all causation on a Presentist picture is simultaneous, rather just that events cannot happen in the past or future on a Presentist picture. I also maintain that without an argument for causation at a temporal distance, all causal chains – even B-theoretic ones – are contiguous; that causation happens of successive moments.

chain must follow the ordering of the moving NOW. If we hold that causation does not happen at a distance but that basic causation happens at successive moments – that causal chains are contiguous, consisting of continuous series of momentary links – then unlike the B-theorist, the Presentist cannot have any kind of basic causation at a temporal distance. This is because they are restricted to ordering times in virtue of the movement of the NOW. It should be noted that I am not intending to deny that causation is transitive, and that *a* causes *e* ‘at a temporal distance’, by way of *b*, then *c*, then *d*. What I deny is that *a* can cause *b* when *a* and *b* are not events in succession. It is the latter sense of ‘at a temporal distance’ that I mean.

Keller and Nelson then claim

*“If causation can be a cross-time relation on the four-dimensionalist view, then it can be one on the Presentist view too. If the four-dimensionalist can say that the occurrence of *c* in 2054 causes the occurrence of *e* in 1985, then the Presentist can say that *c* will occur in 2054 and *e* did occur in 1985, and *e* was the effect of *c* and *c* will be the cause of *e*”* (Keller and Nelson 2001, 431).

However, on a B-theoretic or four-dimensionalist time-travel story causation need not be a relation that happens at a temporal distance (even when there is backwards time-travel, as I will explain in §5.1). Whereas, causation *does* need to be so on the Presentist (and any A-theoretic) picture, because they are not able to subscribe to the local temporal and causal ordering that the B-theorists subscribes to. As I have already explained (see §3.4.3 to §3.4.5), the B-theorist can appeal to personal time to give a local, but contiguous causal chain, and therefore explain why the time-travel story need not involve causation at a temporal distance and hence why the time-traveller can have causal continuity with him or herself over time. So Keller and Nelson are not correct to maintain that the Presentist, like the B-theorist, can claim that a departure event in 2054 can cause an arrival event in 1985, for example. I have given an account of how this is possible on a B-theoretic picture, and will do so further in Chapter Five. But conversely, it is not clear how causation like this is possible on a Presentist picture. This is because there can be no unbroken causal chain that exists between the departure and arrival events.

Lastly, Keller and Nelson finish their paper by stating

*“Should we then say that the Presentist does not really believe in the possibility of time-travel, but only in the possibility of odd arrangements of past- and future-tensed truths? Perhaps we should ... The Presentist is just as entitled to tell time-travel stories as to tell any stories about things that happened in the past or will happen in the future. Even if Presentist time-travel is not real time-travel, the Presentist can be just as committed to the statement ‘There might be time-travelers’ as she is to the statement ‘It might rain tomorrow’ “(Keller and Nelson 2001, 345)*

Yet here Keller and Nelson have ‘perhaps’ agreed with me that Presentist time-travel is not real time-travel. I hold that such a conclusion is correct. At most the Presentist can tell a story of a person with what Sider terms a ‘temporally disconnected life span’ (2005, 330). This is because without personal time to give us a causal link or chain between the departure and arrival events, to give us a genuine alternative ordering of events, and to give us causal continuity between the time-traveller at different times, we do not have a time-traveller in any real sense. It might be said that this is still *some sort* of time-travel story, but as I have argued in Chapter One, such an account or definition of time-travel is not internally consistent, and we should not accept those sorts of accounts.

Finally, the reader should be reminded that Keller and Nelson’s paper was an attempt to show that Presentism is as compatible with time-travel as Eternalist views. In many ways, I did not show they are wrong. This is because it seems that their argument was primarily based on the Presentist vs. Eternalist debate while I have focussed on the A-vs. B-theory debate. Although I mentioned one or two ways that A-theoretic Eternalist views might fare better than the Presentist (also A-theoretic) view, what I primarily showed was that no A-theoretic views, Presentism included, are likely to be compatible with time-travel.

### ***3.5. Monton’s Presentists and their Closed Time-like Curves***



In “Presentists can believe in closed timelike curves” Monton argues that “Presentism is compatible with some stories that involve closed time-like curves [CTCs from here], and that some of those stories are time-travel stories” (2003, 199). I will explain Monton’s account and then show why I disagree with the second part of his claim. I charge that the story he has given is not a time-travel story, and thus he has not offered an instance of a Presentist time-travel story. Nevertheless, he may have succeeded in showing that Presentism is compatible with CTCs as per his primary claim. I do not take a stand on this latter issue.

The story that Monton gives is one of circular time in which “an object [is] living in rolled-up space-time, where  $t_0 = 10$  years. Suppose that the object follows a closed time-like curve so that after 10 years the object comes back to its spatio-temporal starting point” (2003, 201). Monton points out that there are two types of possible worlds that are compatible with comprising such phenomena. Firstly, this could be a world of eternal recurrence “where the various epochs are only qualitatively identical, not numerically identical” (2003, 200). Or alternatively, the world could be one of rolled-up space-time, in which an object existing over time can come back to its temporal starting point by moving forward in time. Monton appeals to Bigelow (1996) to give the past and future truthmakers in order to say that the world is one of rolled-up space-time and not of eternal recurrence. The truth makers would need to be such that they specify that the events or epochs in the CTC are also *numerically* identical to the events or epochs to which they are *qualitatively* identical. This means that it is not just the case that the events are the same event types, rather, they are the same event token; the exact same events are recurring. It is important that we are focussing on the worlds with rolled-up space-time rather than those of eternal recurrence in order for the closed time-like curve and causal loop to be present in the story.

Monton holds that his story counts as time-travel under Lewis’ discrepancy requirement (Lewis 1976, 68) because the duration of the trip is 10 years and that is unequal to the temporal distance travelled – zero years – since the temporal starting point of the journey is the same as the end point of the journey. However, I find this problematic. Firstly, the totality of all time consists in those ten years and the (supposed) time-

traveller has returned to his starting point or departure point by regular temporal existence. Ordinarily, we do not want regular temporal existence to count as time-travel, instead we think of time-travel as something distinct and unusual compared to regular temporal existence. Additionally, Monton's account of time-travel fails because, as I have argued in Chapter One, we need more than just Lewis' discrepancy requirement to demarcate time-travel stories (on my strong conception) from time-travel-like stories and non-time-travel stories. In order to satisfy the 'strong' and internally consistent notion of time-travel, not only do we need the discrepancy feature but we also need what I have termed 'isolation and encapsulation'. It is not enough that the supposed time-traveller returns to his starting point or some earlier point on his lifeline, he also needs to travel there in a way that is discrepant from how non-time-travellers exist in time. This is because, as I have shown in Chapter One, without adding that requirement we are forced by consistency to include a number of cases that we certainly do not want to count as time-travel. Given this, we can reject Monton's story as one of Presentist time-travel since it does not satisfy our definition of a strong time-travel story.

However, even if we were to grant that the discrepancy requirement was a sufficient condition for time-travel, I hold that it is not clear that Monton's time-travel story truly satisfies this requirement of a discrepancy between personal and external time. Whether or not we say that Monton's story includes a discrepancy between personal and external time will depend on how we understand these notions, in this case, particularly the notion of external time. Let me explain further. In Monton's story there is certainly a discrepancy between (a) the time between the departure and arrival events, which is zero years, and (b) the time it took the (supposed) time-traveller to get from the departure place to the arrival place: 10 years. But, there is not a discrepancy between (b<sup>1</sup>) how long it took the time-traveller to get from the departure event to the arrival event, and (b<sup>2</sup>) how long it took all the other people and objects in the same world to get from the departure to the arrival event. There is no discrepancy between how the time-traveller experiences time during their supposed time-travel event and how the rest

of the world, or the non-time-travellers, experience it.<sup>82</sup> In Monton's time-travel story the whole world is essentially time-travelling, along with the time-traveller. This is not what we would intuitively want to count as a time-travel case.

I hold that Monton's (2003) story is not a time-travel story because there is no discrepancy between (b<sup>1</sup>) the experience of time for the time-traveller, and (b<sup>2</sup>) the experience of time for the non-time-travellers. This is because there are no non-time-travellers on Monton's account. The whole world travels forward in time at the same rate and in the same way as the supposed time-traveller. The (supposed) time-traveller is in no way isolated and encapsulated from the non-time-travelling people, or non-time-travelling part of the world, because there simply is no discrepancy between the two. Hence, there is no time-travel in Monton's Presentist, rolled-up space-time world.

### **3.6. Chapter Conclusion**

In this chapter I have rejected accounts of A-theoretic time-travel that have been defended in conversation (as per §3.1) and in various published works (as per Dowe (2009), Miller (2005b), Keller and Nelson (2001), Daniels (2012), and Monton (2003)). I began by showing in §3.1 and §3.2, how under one interpretation of A-theoretic time-travel, we suppose that either the NOW moves around with the time-traveller, or that it remains behind when the time-traveller travels to the objective future or past. This first interpretation leads to a time-travel analogue of the absurdity presented by Braddon-Mitchell (2004) in his "How do we know it is now, now?" paper. Namely, that either the time-traveller or the non-time-travellers, depending on the scenario, end up existing in the past or the future, rather than the present. There is the additional absurdity that we either end up with multiple NOWs which we cannot have on an A-theoretic picture, or we resort to the B-theory's indexical account of the notion of the present.

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<sup>82</sup> Note that I do not mean to suggest that this is a matter of *subjective* experience. By 'experience' I mean to refer to the objective changes that happen to the time-traveller, regardless of his or her awareness or personal experience of those changes and events.

The second, and perhaps more plausible way to understand A-theoretic time-travel – in these cases specifically *Presentist* time-travel – is that it is *not* the case that the departure event (in the present) happens *after* the earlier arrival event (in the past). Rather it is simply the case that the departure event causes it to *have been* the case in the past that there was an arrival event. This second interpretation of A-theoretic time-travel is addressed in the second part of the chapter, §3.4 and §3.5, and it avoids the problems that arise in the first interpretation. It avoids these problems because (in a backwards time-travel case, for example) it denies that it *was* the case that the time-traveller arrived and is existing in the past as per the first interpretation. Rather, this interpretation holds that the time-traveller arrived in the past when that past moment was still present.

But as I have shown in §3.4 and reiterated in §3.5, such a story is not a time-travel story in the strong sense set out in Chapter One. This is because A-theorists are committed to a certain account of the direction of time, namely one in which temporal order is given by the passage of the objective moving NOW. As a consequence, **firstly**, the A-theorist is not able to include personal time in their time-travel story. They can have something *like* personal time, in the sense that the (supposed) time-traveller's *experiences* and *memories* will appear to him to be temporally ordered in a way that corresponds to personal time, but there can be no *time-like* ordering that corresponds to his personal time, as there can be no local temporal ordering on an A-theoretic picture. This is why the relationship between time-travel and the direction of time is so important. I will discuss this in a little more detail in Chapter Five.

**Secondly**, without the use of personal time, the A-theorists' story must include basic causation at a temporal distance in order to account for how the departure event can be (part of) the cause for the arrival event. The A-theorists will also have to give an account of how the (supposed) time-traveller can have personal identity over time given that their temporal existence is not continuous and contiguous in time. I have also shown how this is *not* equally a problem for the B-theorist – contra Keller and Nelson's claim. The B-theorist can have a strong time-travel story, one in which there is a continuous and contiguous causal and temporal chain throughout their time-travel journey (no

causation at a temporal distance). The B-theorist can also have a time-travel story in which there is no question about the time-traveller retaining personal identity across time (any more than for successful non-time-travellers). The A-theorist, however, can only have a time-travel-like story.

# 4 The Direction of Time

This chapter focuses on some issues surrounding the direction of time. I will begin by drawing a distinction between time structure, time direction, and time passage. I will explain time *structure* in terms of a linear axis and the ‘betweenness’ relations on that axis, as well as the simultaneous or coincidence relations that hold between points of time on that axis. Time *order*, *sense*, or *direction* can be understood as one of two things, either the direction through time of the A-theorists’ moving now which we have rejected in Chapter Three, or as the difference between earlier and later, which in turn may be explained by some other features of reality (such as causation or entropy) which seem to have a direction in time; a temporal asymmetry. Exactly how we should understand the notion of direction is one of the main foci of this chapter. Time *passage* is the notion of the moving now which we considered in Chapters Two and Three.<sup>83</sup> After making this distinction (between time structure, time direction, and time passage), I will look at what different philosophers have thought the direction of time could be, especially what it could be on a B-theoretic understanding of time, since I have rejected the A-theory simpliciter, as well as when combined with time-travel. On the B-theory, the orthodox view is that the direction of time *is*, or can be *explained by*, some kind of temporal anisotropy.

I will then argue that the causal theory of time order, as put forward by Reichenbach, amongst others, should be understood as an account of temporal direction or order, and not as an account of structure. This is because the causal theory is attempting to

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<sup>83</sup> It is interesting to note that in his paper, *The Flow of Time*, Price (2007) makes a further distinction between the Objective Present (§2) and Objective Passage (§4). In order to add any further distinctions to my classification table or axis I would need to add additional dimensions to it, i.e., to make the table or axis three or four dimensional. However, focusing on other distinctions that could be made is not central to my aim here.

give an account of what makes an event earlier or later than another event, the theory is not attempting to give an account of the non-directed, betweenness relations that hold between points on an axis.

## **4.1. Preliminaries**

### **4.1.1. Distinctions between Structure, Direction and Passage**

In order to give an explanation of the asymmetries in time, the direction of time and the experience of passage of time I need to first draw a distinction between (i) time structure, (ii) the direction of time, and (iii) the flow or passage of time. This is because I wish to make it clear which of these features – (i), (ii) or (iii) – are accounted for by each of the different theories that we will consider in this chapter.

#### **(i) Structure**

Let us start with (i) structure. Consider a spatial or linear analogy of a chain.<sup>84</sup> The links on a chain are in a certain position relative to one another. We can flip the chain around, or we can hang it from the other end in order to change the direction or order<sup>85</sup> of the links on the chain. But when we do this the linear structure, position or placement of the links in the chain does not change. The structure is what remains invariant when the axis or point of reference is moved. What does change, however, is whether we consider the links to be in the upwards or downwards direction relative to other objects, or in the to the east-of direction or the to-the-west-of direction. So in order to prevent us from imagining the links on the chain as having a certain order or having directed spatial relations with regards to other links on the chain, let us imagine this chain in empty space. We should then agree that whatever way we may look at the

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<sup>84</sup> Reichenbach (1956, 26) gives an example very similar to this, using points on a line.

<sup>85</sup> Notice that the term order can be a ambiguous term – ambiguous between order in the sense of a basic structure and in the sense of a direction. I will attempt to disambiguate the term by being clear which of the two ways I mean to use it, or by using the terms direction and structure instead.

chain, the structure of the links on the chain stays the same. We can arbitrarily label one end of the chain  $X$ , and the other  $Y$ , and say that some link on a chain is in the relation of being closer to  $X$  than some other link on the chain, and therefore further in the direction of point  $X$  than some other link in the chain. But this does not commit us to any kind of privileged direction to the chain, or even any kind of correct order to the chain, such as  $XY$  rather than  $YX$ . Likewise, we can understand that events in time (analogous to the links on the chain) have a structure or position relative to each other. This structure is independent or separate from any order or direction that those events or space-time may have.

To illustrate this point, suppose the Inspector asks Miss Marple to recount the events of the murder in the order in which they happened. This is a question about more than just structure; it is also a question about direction (or directed order). The Inspector does not want to know simply about the betweenness relations that stand between the events, he also wants to know which events happened first or earlier, and which events happened later.

Likewise, suppose we are talking about 'local time order' and I ask you to consider a world with three events,  $A$ ,  $B$  and  $C$ , and I ask you to change the order of those events. Order is a somewhat ambiguous term between structure and direction. You might then imagine the events in the order  $C$ ,  $B$  and  $A$ . But really all you have done there is to change the *direction* of your telling of events, the structure of the events is still the same.

To clarify, let us consider the betweenness relation, which is a relation of structure and not direction. Consider the links on the chain again: We can ask of the links whether it is true that link  $B$  is between  $A$  and  $C$ . Our answer will not change regardless of whether or not we are looking at the chain from the direction of the  $A$  end of the chain, or from the  $C$  end of the chain, nor will it change if there is something which passes from the  $A$  end to the  $C$  end, or from the  $C$  end to the  $A$  end.

Gold (1965) gives a similar example in which he talks of three photographs. The first photograph has a ball in the top left hand corner; the second has the ball in the



middle; while the third has the ball in the bottom right. Gold then claims we can put the photographs into the “right *sequence* if they represent sufficiently small time intervals. We can deduce the *sequence* but not the sense [direction] in time” (Gold 1965). For example, we recognise that the photograph with the ball in the middle, photo 2, is likely to be the middle photograph, we can recognise the *sequence* or *structure*, but we cannot tell whether the correct *order* or *sense in time* is of the photos 1, 2, 3 or of the photos 3, 2, 1.

Objects in space or events in time can have structure in virtue of standing in betweenness relations with other objects or events, regardless of any directions that space, time, objects or events may have. So let us take this to be what is meant by structure.

## **(ii) Direction**

Now let us consider what is meant by (ii) the direction of time. Firstly, I need to distinguish between three different ways that we might use the word ‘direction’. In the normal, everyday sense of the word ‘direction’ both space and time have directions. Direction in this sense is what we get when we take some frame of reference and fix a point on the axis – the axis being one dimension of four-dimensional space-time – and give a label (such as ‘the west’ or ‘the future’) to some point or points at one end of the axis or the other. This is sometimes called ‘sense’ in mathematics. The points on that axis (be they objects or events) have temporal or spatial relations to other points on the axis in virtue of their structure.

Points on an axis, for example A, B, and C, will have a structure, and thus they will have relations (temporal or spatial) with regards to one another, such as B having the betweenness relation with A and C. Once we have labelled one end of the axis ‘North’ and the other end ‘South’, directions are generated. Supposing that A is at the end of the axis that we have labelled ‘North’, A will then be said to be further in the northerly direction than B, and C further in the southerly direction than A. As well as positions relative to a direction with regards to other points on an axis (which is the first way we

might use the term direction) we can also make claims about movement *in* or *towards* a direction, such as movement in the northern direction from C to A (which is the second way we might use the term direction).

In these first two senses, both time and space have directions. Space has directions such as downwards, and northwards, and things in space can move from the north to the south, south to north, from left to right, right to left, and so on. In the same way, time too, can be said to have directions, one from the big bang to the big crunch,<sup>86</sup> from earlier to later, and the opposite direction from the big crunch to the big bang, from later to earlier. We can list the events that happened yesterday in what we call the ‘backwards’ direction, from later to earlier, or alternatively in what we call the ‘forwards’ direction, from earlier to later. Whether or not there is an objective difference between the ‘forwards’ direction and the ‘backwards’ direction, between the big bang and the big crunch, is something that Price (1995, 2009) discusses, and we will return to this later in the chapter.

However when we talk about ‘the direction of time’ we mean something more than direction in these normal senses of the word ‘direction’ – of which time has two.<sup>87</sup> We think that time is *directed* in a way that space is not. This is the third and special way that we might use the term ‘direction’ when talking about time, as a kind of *directed order* or *privileged direction*. Often when we think about the direction of time, we think of the direction of the passage of time – the direction in which time, or perhaps time’s moving NOW, passes; the direction which it moves towards. In this sense the direction

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<sup>86</sup> I do not mean to presuppose that the actual world is one that goes from big bang to big crunch; this is merely an explanatory tool.

<sup>87</sup> Here I am assuming that time is one-dimension. If we consider dimensions to have a linear structure, then each one dimension will have two directions in the normal sense of the word direction. Grünbaum makes a similar point, “For so long as the states of the world... are ordered by a relation of temporal betweenness having the same formal properties as the spatial betweenness on a Euclidean straight line, there will be two time senses which are opposite to each other” (Grünbaum 1967, §1).

of time, the third way we might use the term direction, is similar to the second way – it is the movement of something in a direction. However, we have rejected the A-theorists’ moving NOW conception of the passage of time based on its unacceptable consequences when combined with time-travel (in Chapter Three), as well as its unacceptable consequences simpliciter (in Chapter Two). Thus we either need another conception of time’s direction that does not explain the direction of time as being the direction of the (objective) passage of time, or we must do away with the notion of an intrinsic, objective direction of time, as Price (1995, 1996b, 2009) does.

Three Structures:	Two directions:	
	<i>ABC</i>	<i>CBA</i>
	<i>BCA</i>	<i>ACB</i>
	<i>CAB</i>	<i>BAC</i>

Figure 9: Structure and Direction

To give one final illustration of the terms of structure, order and direction, suppose we have three points on an axis – and those three points can be events in time, or objects in space – and they are represented by letters A, B, and C. There are three ways that those three points could possibly be structured or placed with regards to one another: ABC, BCA, CAB – in each of the three possible structures a different letter or point is in the betweenness-relation with the other two points. Given that a single line or linear axis has two directions (XY and YX) we can use those two directions to generate two orderings per structure (ABC and CBA, BCA and ACB, CAB and BAC) giving us a total of six possible orderings of the three letters or points on the axis. This can be represented as a table (see figure 9), with three structures and two directions, giving us six orderings in total. However, supposing that time is one-dimensional, there will only be one actual structuring of the three events (or points on the axis), and let us suppose

that the structuring is in fact ABC. Then that structure will have two possible orderings: ABC and CBA, which correspond to the two directions: XY, and YX.<sup>88</sup>

### **(iii) Passage**

The passage or flow of time (iii) is something more than just a directed order of events in time; it is the *moving NOW* conception of time that the A-theorist argues is both a fundamental and objective feature of time. The objective passage of the NOW through successive moments involves the A-theoretic claim that I have rejected in Chapters Two and Three. The A-theory is not the view that there are multiple NOWs all of which are moving in one direction, rather there is a single NOW that moves along the dimension of time. As we saw in Chapter Three, in order for an account of the moving NOW – such as C. D. Broad's (1923) moving spotlight theory – to make sense, it requires us to postulate a hyper-time within which the spotlight or the NOW passes through time. This consequently leads to various other problems such as McTaggart's paradox (in which all moments of time have mutually incompatible properties). In turn it leads to McTaggart's infinite regress in which we must employ infinite layers of super- or hyper-time in order to explain the layer before. As discussed in Chapter Three, on the A-theoretic view we are also presented with the possibility that it is not NOW, now (Braddon-Mitchell 2004), which poses serious complications when combined with time-travel (as per Chapter Three). An alternative claim would be that there is not a single moving NOW, but multiple moving nows. However, this reduces to a B-theoretic view of time – like the one we are working with here – in which the present is merely an indexical and the *apparent* passage of time is to be explained in terms of some asymmetry in time.

Lastly, the *psychological* experience of time is a key feature of the passage of time. It is not only the case that at any given moment we remember the things that came before, but we also think we experience a continuous and successive movement of time, which

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<sup>88</sup> Again assuming that time is one-dimensional and thus only have two directions, directions being used in the regular sense of the word direction.

then passes into memory. The B-theorists deny that there is an *objective* passage of time, but what cannot be denied is that there is a very real *feeling* of a passing of time. Thus the B-theorist must give an account of the direction of time (ii), as well as of the *experience* of the passage or flow of time, whilst denying the objective existence of the passage of time (iii). I will give such an account in Chapter Five. In the following sections I will argue for a causal theory of time which will give us an account of the direction of time (ii). But I will also endorse the view that there is no objective direction of time, and that we assign a direction to time by convention. In Chapter Five I will explain how my endorsement of this conventional understanding is compatible with my endorsement of the causal theory of the direction of time. In Chapter Five, I will also use the causal theory of time to account for the apparent passage of time (as I touched on §3.4.3) and I will also discuss some interesting results when we combine the causal theory with time-travel.

#### ***4.1.2. The Disanalogies between Time and Space***

In order to fully illuminate the problem of the direction of time, we should consider some disanalogies between time and space. Then we will move on to some individual asymmetries in time. We will consider some possible explanations and explanandums for those asymmetries.

Both time and space have a structure (i), and space-time's events and objects have a temporal or spatial position. By considering some event or object and its relation to another event or object we can generate directions and orderings, as in the case above where some links on a chain were further in the X-direction than some other. Both space and time have direction in this normal, common use sense of the word. Objects in space may be to the left or right of other objects, to the north or south of other objects, above or below other objects. Likewise events in time may be earlier or later than other events, before or after other events. This kind of direction is generated by assigning an arbitrary reference point to the temporal or spatial structure, and naming the relations that the events or objects have to one another. Importantly, we seem to think that time also has (ii) a *privileged* direction, a direction that we call *the* direction, of

which space has no counterpart. When we move forwards in one direction through space, say, northwards, we can then return to our original position by moving in the opposite southwards direction through space – this is the regular sense of the notion of direction. Space does not have a *privileged* direction like we think time does. Space does not restrict us to move along in one direction and not return. However, time does. When we travel towards the future, as per normal existence, we cannot return to previous moments, as we can to places we have previously visited. In time, our movement is in one direction only – time has a privileged direction; time itself seems to be directed.

Time-travel may present a counter example to the claim that we cannot return to previous moments, however it need not be counter to the claim that our movement is in one direction only. As I have argued in §3.4.3, and will argue in §5.1, even when returning to earlier moments the time-traveller continues to move *forward* in time. Supposing time-travel can and does occur, it is still at least true that *for the most part* we cannot move freely around in time, like we can in space.

The A-theorists would argue that a second dissimilarity between time and space is that time has a passage or flow (iii), whereas space does not. While we can move *through* space and thus experience a passing through space, we do not experience a passing *of* space itself. But with regards to time, it is not that we simply experience a passage of flow of time when we move through time, instead it seems we *always* move through time, and thus (whenever we are consciously attending to it) we constantly experience the flow or passage *of* time. The passage of time, unlike a passage through space, seems to apply to everyone and without fail. Some people and objects will move through space, while others will remain stationary, yet all things (seem to) move through time.

But the passage of time (iii) or the notion of a moving NOW involves more than just the claim that there is a direction to the movement through time. As we saw in the previous section, and in Chapter Two, the A-theorists claim that the passage of time involves a *single* moving NOW. This means that there is only one moment of time that is NOW. Under this understanding, it also means that everybody's 'now' is the same now,

while everybody's 'here' need not be the same 'here'. For example, if I am on my porch and I call a friend at the shops via cell-phone, it is true that we are at the same moment of *time*, but we need not be at the same area of *space*. The A-theorist would argue that this highlights the difference between space and time – there is only one 'now', but there need not be only one 'here'. However, this example need not convince us to adopt the A-theorists' idea of a single moving now. It has been built into the story that my friend and I are at the same moment, but not at the same place. This also follows from what we know about how cell-phones work – they do not call people in other times (although they might call people in other time *zones*). I could just as easily tell a different story in which I use a 'cell-phone2' and call a friend at the same *place* yet in a different *time*. The more interesting and perhaps telling fact, is that we have the ability to access (or contact people in) different places at the same time (cross-spatially), but not the ability to access (or contact people in) *the same place* but at *different times* (cross-temporally) – except of course in the most mundane of ways, such as leaving a note on the fridge in order to remind oneself of something later that day (an uninteresting way to send a message to the future). For example, while I can go into the city, and then go home again, I cannot go into the future (as one does in regular temporal existence) *and* then go back to when I came from. Thus, the real dissimilarity between space and time (leaving out the A-theorists' moving now) is this inability to freely move around in time, as we do in space.

The A-theorist would claim that at any given moment of time others who exist at that moment of time are at the same moment of time. But they would also claim that it is not the case that at any given moment of time, others who exist at that moment of time are at the same area of space. To say it simply, people can be at different places, or 'here's, but not at different times, or 'now's. 'Now' is the same for everyone, says the A-theorist. The B-theorist, however, will object and claim that 'now' is merely an indexical, in just the same way that 'here' is, and that in this respect there is no difference between space and time. They will argue that it is a trivial truth to say that "at any given moment of time others that are existing at that moment of time are at the same moment of time". B-theorists will also claim that the correct spatial analogy is not "at any given moment of time, others that are existing at that moment of time are at the

same area of space”, instead it is “at any given area of space, others that are existing at that area of space are at the same area of space”. This reduces to a trivial truth which is analogous to the temporal claim, and thus it does not illustrate any dissimilarity between space and time.

Given that in Chapters Two and Three we rejected the possibility of the A-theorists’ single, objective, moving NOW the B-theorist need only give an account of the *experience* or *appearance* of (iii) the moving now, not an account of any *objective*, moving NOW. The problem of the *experience* of the moving NOW will be addressed briefly in Chapter Five. But because the B-theorist has rejected the moving NOW they must also give an account of (ii) the direction of time without appealing to the direction or passage of the NOW. That will be done later in this chapter (§4.2 and §4.4).

Reichenbach (1958 [1928]) presents a number of dissimilarities between time and space, additional to the ones I have discussed. There are two that I will briefly mention. One difference is that space has three dimensions – length, width, and height – while time only has one dimension, with the directions earlier and later. Secondly, Reichenbach points out that time is “allotted a primary position among conscious experiences, and is felt as more immediate than the experience of space” (1958 [1928], 110). Our thoughts seem to have a position in time whereas they do not seem to have a position in space. However, if we instead suppose thoughts to be mental events such as the firing of neurons, then we can say that they do have a place in both space and time, their place in space being in the brain. Therefore, thoughts are not an example of a disanalogy between space and time.

One important difference between time and space is that causation has a preferred direction in time, but not a preferred direction in space. Suppose I hit a billiard ball with my pool cue and a moment later it rolls *westward and to my left*. There is nothing mistaken in supposing that I could just have easily hit the ball on the other side at the first moment and that it therefore rolled *eastward and to my right* the moment later. The spatial direction in which the cause influences its effect is contingent upon other facts in the world, such as how I held my pool cue, the transfer of energy, the direction of



forces, and so on. However there is something mistaken in supposing that I could have hit the billiard ball and caused the ball a moment *earlier* to roll off in some direction (unless of course we suppose that the event the moment earlier was not causally connected to the hitting of the billiard ball and then there is no problem in supposing that sequence of events). The point here is that we can act so as to cause something in a different spatial direction, but not in a different temporal direction; this is a counterfactual with regards to space, for which there is no analogous temporal counterfactual. However, in Chapter Five I will explain that the apparent asymmetry of causation is a feature of the way in which our memories accumulate, and that causation is not intrinsically asymmetrical.

#### **4.1.3. Temporal Asymmetries**

We should ask whether causation's temporal direction another difference between time and space, or if it is part of the difference already mentioned – that time has a direction while space does not. Like causation, it seems as if there are a number of other features of reality that have a temporal direction yet not a spatial one. Many authors, such as Dainton (2010, 46), Hawking (1988, 153), Horwich (2009, 37), Le Poidevin (2003, Ch12), and Mellor (1998, 119) mention features such as the entropic asymmetry, knowledge asymmetry, memory asymmetry, action asymmetry, and so on, as features which display a temporal direction, yet no spatial direction. Dainton calls these features *content asymmetries* (2010, 46) because they are asymmetries of the *contents* of time. The distinction between two types of temporal asymmetries – (a) content asymmetries or asymmetries in time, and (b) asymmetries of time itself – is an important distinction to keep in mind for the remainder of the chapter. Whether or not asymmetries in the *contents* of time amounts to the same thing as asymmetries *of time itself* will depend on whether one is committed to a Substantialist or relationalist view of time – i.e., whether or not space-time is just the objects and events that occupy it, or something more. I will return to this issue, as well as which view the causal theory of time is committed to, if any, in §4.4.3.

Space does not exhibit any of the content asymmetries that time does. It may be thought that this is because space does not have a privileged direction, which would imply that the notion of privileged direction, or the direction of time, is somehow bound up with the content asymmetries. I will explore this in more detail in §4.2 when I discuss the relationship between the direction of time and temporal asymmetries (both asymmetries *in* and *of* time).

The B-theorist cannot explain any of these asymmetries by appealing to the A-theorist's moving NOW because they deny the (objective) passage of time. Therefore the B-theorist must give an account of these features and the apparent direction and passage of time in terms of something other than the A-theorists' moving NOW. Before we move on to the B-theorists' explanation of the direction of time and of the experience of the passage of time, we should first consider these content asymmetries and what exactly needs explaining.

One of these content asymmetries is entropy (or disorder) which increases over time (or, in the direction which we call earlier to later). Milk spreads out through coffee, cups fall and break, bodies decay, books disintegrate, energy is expended. These events seem to happen in one direction only; we do not observe milk separating itself from coffee, books, and bodies coming together again out of the dust. Explanations are also usually temporally asymmetric. We tend to explain events in reference to earlier events –in some cases we may act based on beliefs or hopes about the future, but these beliefs or hopes can too be explained in reference to events or facts about the past. Our knowledge is temporally asymmetric. While we may make correct *predictions* about the future, we do not usually claim that we have *knowledge* about the future. Likewise our memories are temporally asymmetric; unlike Carroll's (1871) White Queen,<sup>89</sup> we remember the past only; we do not have memories of the future. Our actions are asymmetric in that they are directed towards affecting the future and not the past, “no one spends time wondering what to do yesterday” (Dainton 2010, 46). The action asymmetry may be due to the causal asymmetry already mentioned, that causation

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<sup>89</sup> “It’s a poor sort of memory that only works backwards” said The White Queen.

works from earlier to later. In turn, counterfactual conditionals are temporally asymmetric (except perhaps in time-travel stories); the antecedent is the earlier, the consequent the later. Dainton (2010, 408) also mentions a radiation asymmetry, ripples of water or light radiate from a common source, they rarely move towards a common point and converge. These, and other features, exhibit a temporal asymmetry, a preferred direction in time.

## 4.2. *The Relationship between Asymmetries and Direction*

In §4.1.1 we worked with the notion that the direction of time (ii) – since it could not be the direction of the passage of the now – should be understood as the difference between the two directions in time, and perhaps also that it requires some kind of privileged status of one of those directions.<sup>90</sup> In this chapter I will survey various views (mainly B-theoretic) on the role that temporal anisotropy or asymmetry plays in either itself *being*, or *creating* time’s directionality. Firstly I will present the A-theoretic view that the direction of time is the direction of passage, notion (I). But since we have already rejected the notion of objective passage in Chapters Two and Three I will then move on to the more promising, ‘orthodox’ view that the direction of time is some kind of asymmetry in time, notion (II). I will then present some reasons why temporal asymmetries do not give us a direction in time, notion (III), and present the possibility that there is no single, privileged direction in time, notion (IV). Finally I will present my view, notion (V) that while the content asymmetries can give us temporal orientability and an objective difference between the two directions in time, I hold that there is no fact of the matter about which is the earlier and which the later, other than convention. By this I mean that I will present the idea that there are only *directions* in time and that any assignment of a privileged direction is to be given by mere convention.

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<sup>90</sup> Remember from §4.1.1 that I explained how every linear dimension has two directions, thus time has two directions in this sense. But in the case of time we consider one of those two directions to be privileged; to be *the* direction of time.

It should be noted that while I hold a causal theory (as I will defend in §4.4.) I do not hold a causal theory of *the* direction of time. Rather I take a causal theory of directions of time (plural). I hold that the causal theory does not give us a privileged direction of time, because I simply deny there is such a thing on the B-theory. I merely hold that causation gives us a way to differentiate between the two directions: the XY direction and the YX direction. We can then give a conventional definition to assign one of the directions, for example XY, to be considered *the* direction of time. In Chapter Five I will explain how my endorsement of the causal theory of the direction of time can be compatible with my endorsement of a conventional account of the direction of time.

#### 4.2.1. *The Direction of Time as the Direction of Passage (I)*

Firstly, let us survey various authors or passages that support the notion that the direction of time is the direction of passage. In his book, *Asymmetries in Time* (1987), Horwich claims:

“ ... those who proclaim the anisotropy [asymmetry] of time are ... gripped by a certain metaphysical picture. They have in mind that time is more than just a fixed sequence of events ordered by such relations as later than and simultaneous with, but that it also contains a peculiar property – being now – which moves gradually along the array in the direction from past to future” (Horwich 1987, 15-16).

This passage would suggest that Horwich is one who thinks that the anisotropy or asymmetry of time is *necessarily bound up with* the passage of the NOW, or, that the anisotropy of time is *itself* the direction of time and the direction of time is the direction of the passage of the NOW. If so, I do not think that he is correct. The **first objection** is that *while it may be the case that the passage of the NOW is an asymmetry, it is not the case that any asymmetry must be the passage of the NOW*. The passage of the NOW, if it exists, need only be one kind of asymmetry. Thus it need not be the case that one who proclaims the anisotropy of time is gripped by an A-theoretic, moving NOW picture. The two directions of time *can* be different or anisotropic on a B-theoretic picture (on a picture without objective passage).

This is the **second objection**: It is almost certainly true that “the inspiration for speaking about ‘the’ direction of time derives from the supposition that there is a transient ‘now’ or ‘present’ which can be claimed to shift so as to single out the future direction of time as the sense of its ‘advance’”(Grünbaum 1967, 221).<sup>91</sup> But it is at least possible, even if it is not correct, that the notion of the direction of time could be explained by, or refer to, the direction of some other asymmetric process *in* or *of* time.

**Maudlin** (2007), a realist and non-reductionist about both the direction and the passage of time, defends the idea that the direction of time does not depend on the content asymmetries, i.e., that the direction of time is not given by the asymmetries or time reversal invariant processes – a view that Earman terms ‘the Heresy’ (1974, 20). While Maudlin and I both want to endorse the heresy, we do so in different ways. Maudlin wants to endorse the heresy because he thinks that the Direction of Time is not reducible to content asymmetries, or, depending on interpretation, because he holds that the Direction of time *just is* the Direction of Passage. Whereas I want to endorse the heresy to the extent that I hold there is no direction of time, as per notion (V).

Maudlin maintains that the direction of time is an intrinsic, unanalysable feature of time, which is global and fundamental (meaning that it is not local, but the same all over the space-time manifold). However, Maudlin also claims that “[t]he passage of time ... grounds the distinction between sequences which run from past to future and sequences which run from future to past” (Maudlin 2007, 109). If we understand the direction of time to be the difference between the two directions (and perhaps also privileging one of those directions) then we can interpret Maudlin here as saying that the direction of the moving now (from past to future), as well as giving us the direction of *passage*, it also gives us the direction of *time* because it gives us a privileged direction. That privileged direction being: from past to future, and not the converse, from future to past. However it seems that this is not what Maudlin intended. Given that he thinks

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<sup>91</sup> And that our pre-theoretic notion of the direction of time is that of the direction of the NOW.

that the direction time is an *intrinsic* and *unanalysable* feature of time, he may not want to reduce or explain the direction of time as the direction of passage.<sup>92</sup>

While Maudlin claims that he “want[s] to positively promote the Heresy” (2007, 108) it seems, nevertheless, that Maudlin cannot escape asymmetries, and that he is bringing some kind of story about asymmetry in to his account of the direction of time. Maudlin states that

*“The passage of time is an intrinsic asymmetry in the temporal structure of the world, an asymmetry that has no spatial counterpart. It is the asymmetry that grounds the distinction between sequences which run from past to future and sequences which run from future to past”* (Maudlin 2007, 108)

Here it seems that Maudlin is explaining the *passage* of time the way that the *direction* of time is often explained – by appealing to the difference between the past and the future, or, the difference between the earlier-later direction and the later-earlier direction. Yet here we are not concerned with the notion of the passage of time, since we have rejected it in Chapter Three. Instead we are concerned with the notion of the direction of time. However Maudlin then claims,

*“The passage of time is deeply connected to the problem of the direction of time, or time’s arrow. If all one means by a ‘direction of time’ is an irreducible intrinsic asymmetry in the temporal structure of the universe, then the passage of time implies a direction of time. But the passage of time connotes more than just an intrinsic asymmetry: not just any asymmetry would produce passing”* (Maudlin 2007, 109)

Here Maudlin seems to be saying that the *passage* of time would give us a *direction* of time because the passage of time is an asymmetry. But Maudlin is also saying that we need more than just any asymmetry, because the asymmetry needs to be one that produces temporal passage and therefore gives us a direction of time. However, while Maudlin may need this for his theory of the passage and the direction of time, we do not

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<sup>92</sup> A closer reading of Maudlin’s *The Metaphysics within Physics*, makes this no clearer, as Maudlin seems to suggest both that (a) the direction of time depends on the direction of *passage* (the latter being an intrinsic unanalysable feature of time), and that (b) the direction of time is itself an intrinsic unanalysable feature of time, not dependent on passage.

need a notion of the direction of time that can also account for passage (or vice versa), as I have rejected the notion of an objective passage of time in Chapters Two and Three. At most we need an explanation of our *phenomenal* experience of passage – which I will account for in Chapter Five.

We should ask, then, how Maudlin’s “asymmetry in the temporal structure of the universe” manifests itself, if at all. An **objection to Maudlin** is that we might imagine that there are some possible asymmetries in the temporal structure of the universe (asymmetries *of* time) which may not produce any asymmetries *in* time – the latter are what Dainton calls ‘content asymmetries’ (2010, §4.2). For example, Price (2009, §3.9) presents a case of a world in which time is finite in one direction and infinite in the other. It is at least conceivable that in a world such as Price’s there might be no observable consequences of the temporal asymmetry at all, such as a causal asymmetry or entropic asymmetry. The world’s inhabitants may not experience a passing of time, and they may not be able to orient themselves in time. An issue that is raised here is whether or not it is the presence of the asymmetries *in* time (i.e., content asymmetries), that gives time its direction, or alternatively whether it is an asymmetry *of* time itself (not time’s contents) that gives time its direction. If it is the content asymmetries that are responsible for the direction of time then it is not clear what role there is left for asymmetries *of* time itself to play in generating a direction of time (unless the asymmetries *of* time itself produce the content asymmetries). But, there is a problem: If it is possible for time itself to be symmetric while its contents are asymmetric, or for time’s contents to be symmetric while time itself is asymmetric, then the fact that there are content asymmetries is not a reliable guide to whether or not *time itself* possesses the asymmetry that Maudlin requires. This highlights the possibility that asymmetries *in* time, and asymmetries *of* time, are independent from one another. Therefore, whether or not these content asymmetries can be irreducible and intrinsic, like Maudlin requires for passage and direction, remains to be seen.

#### 4.2.2. *The Direction of Time as Temporal Asymmetry (II)*

Let us consider now the most popular alternative to notion (I), the notion that the Direction of time is given by the content asymmetries. Given that we have rejected the A-theory's notion of the moving NOW, we either need another conception of time's direction that does not explain the direction of time as being the direction of the (objective) moving NOW, or we must do away with the notion of an intrinsic, objective direction of time, as Price does. With regards to the former option, which I will focus on in this section, the orthodox view amongst B-theorists is that the asymmetries in time may give us the direction in time, and even account for the *appearance* or *experience* of a passage of time, but that the theory should not account for any *objective* passage of time, as we have done away with that possibility. On this view, the direction of time could perhaps be reduced to: the direction in which entropy increases (the thermodynamic account); or the direction in which we can causally effect the world (the causal account); or the direction in which the universe expands (the cosmological account); or the direction in which we experience what we call passage (the psychological account). There are many asymmetries, such as these, *in* or *of* time that could be the key to the direction of time. This seems to be the orthodox view amongst B-theorists, so much so that Earman calls the alternative the 'heresy' (1974, 20).

It may be the case that the asymmetries which are responsible for the orientability of time and the difference between time's two directions are merely asymmetries *in* time (or content asymmetries), and not asymmetries of time itself. For example, consider the difference between Price's world (which I used as an objection to Maudlin in §4.4.1), in which time is finite in one direction and infinite in another, versus a world in which entropy increases in one direction and decreases in the other (Price 2009, §3.9). The former world is clearly a case of an asymmetry *of* time itself, whereas the latter world might be a world in which the *contents* of time certainly are asymmetric yet time itself is not. This would suggest that if we want temporal asymmetries to account for the direction of time (assuming we have rejected the A-theorists' appeal to passage of the NOW), then asymmetries *in* time, rather than *of* time, might be where we need to look for such an account or explanation. Note that there is then a further distinction to be



made amongst the content asymmetries; those that are nomological asymmetries and those that are *de facto* asymmetries. A nomological asymmetry would be a content asymmetry which is ensured given the laws of nature or physics (or nomologically necessary), whereas a *de facto* asymmetry would be an asymmetry which, while it remains constant with no exceptions, it is not set by a law of nature – it appears to be accidental in some sense. There is debate amongst philosophers and physicists about whether various asymmetries in time, such as entropy, are to be understood as nomological or *de facto* asymmetries.<sup>93</sup>

**Mellor**, it seems, is another philosopher who takes this orthodox option when he claims that “the direction of time is the difference between being *earlier* than something and being *later* than it ...What then is the direction of time: how *do* earlier and later differ? The answer is that they differ in their consequences, notably ... perception and action ...” (Mellor 1998, 118). It seems that Mellor is claiming that there is a direction of time, and that the direction of time is given by the content asymmetries, such as the asymmetries of action or perception. Mellor claims that “the direction of time is the difference between being *earlier* than some thing and being *later* than it” (1998, 118). On Mellor’s understanding the two directions of time being different is what gives us a direction of time. If all that is required for the direction of time, on Mellor’s view, is that the two directions of time be different, then this suggests that anything that can make those two directions of time different can provide time with a direction. Mellor thinks that *causation* is the answer and that it can account for various content asymmetries, such as the two which he mentions: perception and action. Mellor also presents some arguments in order to reject the alternatives to the causal theory – alternatives such as the entropic asymmetry, the cosmological asymmetry, and the radiation asymmetry. But, surprisingly, Mellor claims that “irreversibility has nothing to do with what gives time its direction. The fact is that the direction of time does not depend on the existence of irreversible processes” (1998, 120). How can Mellor claim

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<sup>93</sup> For a discussion of whether or not entropy is a nomological or *de facto* asymmetry, given that the statistical formulation of the second law is time reversal invariant, See (Callender 1997, 2011; Price 1995). I will not discuss this issue further.

that the direction of time depends on the asymmetry of causation, yet deny the role of irreversible processes? It seems that Mellor is making an implicit distinction between irreversible processes, and asymmetric processes. For consider his statement: “...what gives time its direction is not an irreversible process...but the direction of causation, i.e. the asymmetry of the cause-effect relation” (1998, 121), in which he denies one and asserts the other in the same sentence. We may think of causation as being an *irreversible process* because we think of it as an *asymmetry*, but it seems that Mellor does not. It appears that by ‘reversible processes’ he is specifically referring to those governed by entropic, cosmological and/or radiation asymmetries – which he rejects as the key to time’s direction. In his book, *Real Time II*, Mellor does not discuss what the direction of time is much more than this, he instead moves on to issues such as how the causal theory can give us an account of time order.

Another philosopher who may take the orthodox view is **Horwich**. In Chapter Three of his book, *Asymmetries in Time* (1987), Horwich seems to use the terms ‘anisotropy’ and ‘direction’ interchangeably, which suggests that he understands direction and anisotropy (asymmetry) to be the same thing. Additionally, when he is talking about ‘anisotropy’ he quotes Reichenbach, at length, talking about ‘direction’:

“A ... characterisation of anisotropy is given by Reichenbach (1956, pp. 26-27):

*When we say that a line, though serially ordered, does not have a direction, we mean that there is no way of distinguishing structurally between left and right...*

(Horwich 1987, 38)

However, Horwich then maintains that “Despite his [Reichenbach’s] use of the expression ‘having a direction’ with its potentially misleading ‘moving now’ connotations, Reichenbach is in fact concerned with the general concept of anisotropy” (Horwich 1987, 39). I think Horwich is mistaken in maintaining that Reichenbach does not mean to be talking about *direction*, and instead means to talk about *anisotropy*. Reichenbach may very well be meaning to talk about both, believing that the anisotropies *of* or *in* time are tied up with time’s direction. The fact that in Reichenbach’s works, he defended both a causal and a thermodynamic account of time

order/direction, certainly suggests so.<sup>94</sup> As I mentioned before, I disagree with Horwich that talk of time ‘having a direction’ need tie in with some kind of moving NOW notion. My question in this section is what ‘having a direction’ could mean on a B-theoretic picture; my question is not solely concerned with anisotropies. I also disagree with Horwich that Reichenbach was “in fact concerned with the general concept of anisotropy”, I think Reichenbach’s question may have been similar to mine – what could the direction of time amount to on a B-theoretic picture?

Horwich claims that “[a]nisotropy of time is an *intrinsic* dissimilarity of the past and the future directions: a difference that would be manifested in some time asymmetry within our laws of nature” (1987, 37). I will interpret ‘intrinsic’ dissimilarity, as an asymmetry of time itself, while a ‘relational’ asymmetry is an asymmetry in time – a content asymmetry. Given that we have just interpreted Horwich as understanding the direction of time as time’s anisotropy/asymmetry, then this suggests that Horwich thinks that what it would be for time to have a direction is that the two directions of time are different and distinguishable. He may think this either because he believes the asymmetry of time itself *grounds* the temporal content asymmetries (asymmetries in time), or because the asymmetry of time just *is* the temporal content asymmetries.<sup>95</sup> Horwich’s requirement for an intrinsic temporal asymmetry faces the problem that I have just raised – *time itself may be asymmetric yet its contents not*. Horwich also presents a problem for his claim that in order for time to be asymmetric the anisotropies need to be intrinsic and not relational. He points out that the problem is in knowing which features of temporal directionality are intrinsic and which are relational (1987, 39-40). Horwich holds that the possession of a nomological property (one that would be ascribed to a direction of time by time-asymmetric laws of nature) *does not constitute* an intrinsic difference between the directions, but we can use it to *infer* an intrinsic

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<sup>94</sup> See (Reichenbach 1956, 1958 [1928])

<sup>95</sup> This distinction might correspond with the distinction between relationist and substantivist conceptions of time. On the former, the content asymmetries just are themselves the asymmetry of time, because there is nothing more to space-time than its contents (objects and events). On the latter, the asymmetry of time itself is somehow responsible for time’s contents being asymmetric. See §4.4.3 for more.

difference (Horwich 1987, 41). He says that for an objective direction of time it would be sufficient, but not necessary, that the anisotropy be built into a law of nature. It would appear that Horwich holds that all nomological asymmetries are intrinsic (asymmetries of time itself), but that not all intrinsic asymmetries are nomological (built into a law of nature). The reason for this is that he thinks we cannot rule out the possibility of future theories in physics in which “some of time’s intrinsic features will be treated as *de facto*...” asymmetries, rather than law-like asymmetries.<sup>96</sup> It seems that Horwich is highlighting the possibility that there might be intrinsic asymmetries in time which we think are only *de facto* asymmetries and not nomological asymmetries. It is worth noting here that Horwich’s aim seems to be to set out an account of what an asymmetry or anisotropy in time would be, rather than what the *direction* of time would be, as such.

According to Horwich, Reichenbach defines directionality (or anisotropy) “as the existence of a *structural* difference between an ordering relation and its converse...” (Horwich 1987, 39). This suggests that Reichenbach thinks that the direction of time can be given by the anisotropy of time, the orthodox view. In his book *The Philosophy of Space and Time* (1958 [1928]) Reichenbach argues for the causal theory, the view that the causal asymmetry (or the direction of causation) will give us the direction of time. But in his later book, *The Direction of Time* (1956), he argues that the direction of causation can be further reduced to, or explained by, the direction of entropy increase.

Notice that the majority of philosophers surveyed in this section, while holding that the direction of time is some kind of temporal asymmetry, they also seem to mostly hold that the asymmetries which are giving us a direction of time are only really giving us a way to demarcate between the two directions in time, rather than giving us a way to assign one of those direction as the privileged direction. I will consider this idea further now.

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<sup>96</sup> The difference here is between what we might call “true” asymmetries (perhaps due to laws of nature) such as “entropy increase *couldn’t* go in the other direction”, contrasted with simply *de facto* asymmetries, such as “entropy increase just *doesn’t* go in the other direction”.

#### 4.2.3. *The Direction of Time is not Temporal Asymmetry (III)*

I want to now look at some authors and passages that suggest we reject notion (II), the notion that temporal anisotropy gives the direction of time – at least to the extent that it gives us a way to demarcate one of the directions as the privileged direction.

**Grünbaum** is one such philosopher. He claims that “the anisotropy of time resulting from the existence of irreversible processes consists in the mere structural differences between the two opposite senses [or directions] of time but provides no basis at all for singling out *one* of the two opposite senses as ‘*the* direction’ of time” (Grünbaum 1967, 221). Here Grünbaum is claiming that while the anisotropy of time might give us reason to distinguish the two directions, we still have no reason to call one of them ‘*the*’ direction of time, rather than another. This is a claim that I want to endorse. It would suggest that the anisotropy in time does not give us *the* direction of time; that it does not give us a single, privileged direction.

**Mellor**, who in §4.2.2 we saw endorsing the notion that the content asymmetries does give us the direction of time (notion II), also claims that the asymmetries can only give us directions in time, not a way of demarcating one as the privileged direction. He states that “the difference [between earlier and later] is not formal,<sup>97</sup> as these relations are not differently related to each other: each is just the other’s converse” (1998, 118). On Mellor’s understanding, the two directions of time being different, or the anisotropy of time, is what gives us a direction of time (notion II). But if there is no formal difference between the earlier and later directions then it is not clear that the anisotropy of time has given us *a* direction of time, rather than just *directions* in time (notions III – V). We are then faced with a further problem: Even if we can distinguish

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<sup>97</sup> I am taking the notion of a “formal” difference between two directions to be one that is more than just two directions being each other’s converse, but rather that there is some special reason to privilege one over the other, such as one of the two directions being the direction in which the objective moving now travels, as in Maudlin’s case (notion I).

between the two directions in time (and the world *is* temporally orientable), what makes one direction the ‘earlier’ and the other the ‘later’? There needs to be some objective fact, not just about the difference between the two directions, but an objective fact about why we should think of one as the ‘earlier’ and the other as the ‘later’. There needs to be some objective fact about why we should think that ‘earlier to later’ is the correct telling of events. We need this if we want there to be an *objective* fact about which direction is *the* direction of time.

**Earman** somewhat defends what he calls ‘the heresy’ – the view that the direction of time does not depend on, or reduce to the content asymmetries. I say ‘somewhat’ because as Maudlin notes “Earman himself does not unequivocally endorse the heresy, but does note that no convincing arguments against it could be found” (Maudlin 2007, 108, in Price 2009, §3.4). Price notes that Earman “defends the view that *if* there is a temporal orientation, then it is not reducible to issues of reversibility and the like” (Price 2009, §3.5). It is this view that Earman calls the heresy, because it is contra the orthodox view that reversibility and asymmetry play a large part in time’s direction. In order to support his position Earman points out (what he takes to be obvious) that there could have been no content asymmetries and the laws of physics could have all been time-invariant or time-symmetrical and yet there would still be a direction of time. He also thinks that the content asymmetries could have been the reverse of what they are, yet the direction of time need not have been the reverse. Again this highlights the independence between the direction of time and temporal asymmetries, and between asymmetries *in* time and asymmetries *of* time.

This idea is not at all as obvious as he seems to think it is. For those of us who think that the content asymmetries do have something to do with the direction of time will outright deny Earman’s claim that the content asymmetries could have been different or nonexistent and there would still have been a direction of time. Price criticises Earman for not explaining what it would be for the direction of time to be the opposite of what it is, nor how the content asymmetries could be in the reversed direction and time be in the same direction. Earman concludes that the world does not come equipped with a time direction, but it seems that Earman has not given us a story about

what it would be for a world to come equipped with a direction in the first place. Price (2009, §3.8) claims that Earman's implicit answer to what a direction of time would be seems to be that some world,  $m$ , and the time reverse of that world,  $T(m)$ , would describe different possible worlds. By this he means that if there is a world with the events  $ABCDE$  and the time reverse of that world,  $EDCBA$ , is not the same world, then each world has a different time direction.

Yet Price thinks that Earman's argument, while intended to support the claim that time's direction and asymmetry is independent of its content asymmetries, actually provides support for Price's claim that "the contents of time ... might be temporally asymmetric, without time itself having any asymmetry" (Price 2009, §3.9). This is because it highlights a point that Price has focussed on: the possibility that the content asymmetries and the direction of time are independent of each other. But if time's content asymmetries do not ground the time itself being asymmetric and thus directed, then what could? Price claims that nothing could, and that there is no objective direction or asymmetry to time itself beyond the content asymmetries.

#### **4.2.4. *There is no Direction of Time (IV)***

We should now consider the possibility that there is no direction of time. We should do this given that we have considered arguments that reject the idea that the Direction of Time is reducible to the Direction of Passage, as per notion (I), and arguments that reject the possibility that the direction of time as temporal anisotropy.

**Price** holds that the objective direction of time is the claim that "there is an objective distinction between past and future, earlier and later" (Price 2009, §3). What this means is that the direction of time is a temporal anisotropy. But, it also means that anisotropy is not sufficient for an objective direction of time. This is because, while an

assignment of temporal orientation or direction requires temporal orientability,<sup>98</sup> it “does not require or imply that there be a unique *correct* assignment, dictated by some objective feature of reality” (Price 2009, §3.2). I endorse this claim.

**Boltzmann** and **Grünbaum** have a similar thought. Boltzmann presents the possibility that there may be no objective direction of time. He says, “For the universe, the two directions of time are indistinguishable, just as in space there is no up and down. However...on the earth’s surface we call ‘down’ the direction toward the centre of the earth...” (1964, 446-7). On Boltzmann's view we could say that outside of a particular framework there is no objective fact as to which direction is ‘the future’ and which is ‘the past’. While we may fix a coordinate frame in order to distinguish between two cases, nothing distinguishes a ‘correct’ coordinate frame (Price 2009 §3.1). Likewise, Grünbaum says

*“Since the instants of anisotropic time are ordered by the relation ‘earlier than’ no less than by the converse relation ‘later than’ the anisotropy of time provides no warrant at all for singling out the ‘later than’ sense as ‘the’ direction of time”* (Grünbaum 1967).

We can see that Grünbaum also raises the concern that even if we have a way to distinguish between the two directions of time, that is not enough for one of them to be *the* direction of time. Grünbaum then goes on to say

*“the anisotropy of time resulting from the existence of irreversible processes consists in the mere structural differences between the two opposite senses of time but provides no basis at all for singling out one of the two opposite senses as ‘the direction of time’.”* (Grünbaum 1967, §1).

Why is this so? Here we can give a defence of Grünbaum’s claim by appeal to Price, who holds a similar view. Perhaps Price’s reason for claiming that temporal orientability does not provide us with a way to single out one of the directions as *the* direction of time (does not provide us with a single temporal orientation), is because Price believes that the concept of temporal direction is bound up with the notion of passage. Perhaps

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<sup>98</sup> Note that “temporal orientation” and “temporal orientability” are not the same thing. The former is the claim that time itself has an orientation or direction, the latter is the lesser claim that we can orient ourselves in time, that there is differences between the two directions.



he holds that the direction of the passage of the now is what gives us a way to delegate that ‘correct’ assignment of the direction. Price says

*“our interest in the issue of the direction of time is guided by an attempt to make sense of the notion of the passage or flow of time. If time has a direction in a sense relevant to passage, then presumably it is the same everywhere – passage is supposed to be global, universal and unidirectional. This implies that a precondition of any relevant notion of the direction of time is that it be possible to assign a temporal direction at every place and time, in a consistent way. In other words, we want to be able to pick a temporal direction, and label it (say) the positive direction, without our labels suddenly changing as we move from place to place.”* (Price 2009, §3.2)

The point that Price is making here is that the idea of there being a privileged direction of time is an A-theoretic concept, necessarily tied up with the notion of the objective moving NOW. Hence there can be no analogue to this on a B-theoretic view. I agree with such a thought.

Additionally, the above passage raises a further issue to do with assigning a *fundamental* or global direction of time – a direction that applies consistently all over space-time. Certainly, if we want to give an account of the direction of time that is bound up with the direction of passage then we will need it to be consistent across all of space time. However, I hold that we do not want nor do we need an account which does that.<sup>99</sup> We have rejected the A-theorists’ notion of objective passage, so we do not need our account of the direction of time to satisfy the requirements of the A-theorist or the passage of time. I think that the requirement for there to be an objective distinction between the two directions is, on a B-theoretic picture, sufficient. The B-theorist will want an account of the direction of time that will allow us to orient ourselves in time, distinguish between the two directions, and perhaps also identify a feature that can account for the *experience* of the passage of time. The B-theorist need not account for any *objective* passage of time.

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<sup>99</sup> This is because in §1.10 and §3.4.3 I have explained time-travel as a type of local time under the causal theory. I will develop this a little further in Chapter Five.

#### 4.2.5. *There are only Directions in Time (V)*

We have rejected the previous notions of the direction of time: such as the direction of time being the direction of passage, notion (I); and the idea that asymmetries can give us a way to privilege one of the two directions in time, notion (II). Therefore I now want to present a positive account that follows from the notions (III) and (IV) and the ideas established in the previous sections. Namely, I want to endorse an account which holds that we do not use temporal asymmetries to demarcate *the* direction of time, since there is not *one* on a B-theoretic account. Rather, there are *directions* in time which are grounded in content asymmetries. Furthermore I propose that if we use anything to assign the title of '*privileged* direction' or '*the* direction of time' to one of the two directions, then we do so merely as a matter of convention. In Chapter Five, I will appeal to memory to explain this convention.

It is clear that the content asymmetries can give us temporal orientability – by this I mean that they can give us directions in time – and we can distinguish between the two directions. However (as I have argued in §4.2.3 and §4.2.4) it is not at all clear how they can give us a temporal orientation, a *single* or *privileged* direction, nor how they can allow us to choose one direction over the other as '*the*' direction of time. In order to understand that orientability can give us directions (in the normal, non-privileged sense of the word) consider space. Space is orientable and there are directions in space, and we can distinguish between those directions in space – there are objects in space which help us orient ourselves in space, and asymmetries in space such as gravity (which gives us up and down) and magnetic fields (which give us north and south). But despite this, we do not think of space as having a privileged direction. Therefore we should agree that orientability, while it may give us directions in space or time, it is not sufficient for a direction *of* space, or *of* time, i.e., it is not sufficient for a privileged direction. Price points out that there could be a possible world where time is finite in one direction and infinite in another and that in this case “...it would seem reasonable to say that time itself was anisotropic [asymmetric]. But what relevance would factors like this have for the existence or orientation of an objective distinction between earlier and later...?” he asks. Price is pointing out that even if the asymmetry was certainly an asymmetry of

time itself, and not just of time's contents (content asymmetries) this does not necessarily give us a direction of time, as explained in the objection to Maudlin in §4.2.1.

I think that Price is slightly mistaken to imply that an asymmetry (be it of time itself, or time's contents) does not give us an objective distinction between the earlier and later directions.<sup>100</sup> If by an objective distinction between the past and the future directions we mean simply that we can tell the difference between the two directions and can tell our orientation in time, and we mean that that difference is based on some objective feature of the world, then we would say that in our world there is an objective distinction between past and future. This is a view that I am happy to endorse. However, there are a few stronger ways of understanding this notion of an objective distinction. One is Maudlin's (previously discussed) requirement of the distinction being of time itself and not just of the contents of time. The second way of understanding this notion of an objective distinction in a stronger sense seems to be the kind of distinction that Price denies can be given by the asymmetries, and so do I. Suppose one understands the notion of an objective distinction between past and future to mean an objective way of distinguishing, not just a difference between the two directions, but also as way of distinguishing which is the future direction and which is the past direction (not just which we *call* the future and the past), and to distinguish which of those two directions is the privileged direction. If one understands objective direction this way then we should ask how we can know that the arrow really points from past to future, and know that we have not got the arrow around the wrong way. Horwich highlights this concern nicely,

*"It could be that the two opposite directions along the temporal dimension are significantly different from one another, even though neither has the metaphysically special status of being the direction 'in which time goes'. Thus we should be open to the*

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<sup>100</sup> We need to say "the past *direction*" and "the future *direction*", and not just "the past" and "the future". This is because without the added "direction" we are implying that some moments belong to this thing called the past and some to this thing called the future – a distinction which could only be made on an A-theoretic view by consigning moments to either side of the now.

*idea that time is anisotropic [asymmetric], despite having no privileged direction”*  
(Horwich 1987, 37).

If it is this strong sense of direction that Price claims is not given by anisotropy, then I agree. It is not clear what kind of asymmetry of time or in time could give us a reason to non-arbitrarily label one of the directions in time as the past direction and the other the future direction, and to non-arbitrarily decide that the correct telling of events is XY and not YX. Other than the movement of the present, it is not clear what kind could give us a way to decide which of the two directions of time is to be correctly understood as the earlier direction, as opposed to simply labelling it that way by convention. It is also not clear that the notion of some event being *earlier* than some other, or coming *first*, or *before* some other event (as opposed to being further in the X direction than some other event) can even make sense on a B-theoretic picture. This is because once we reject the idea of the NOW moving through time then we cannot say that some event comes *before*, because there is no NOW which happens upon that event first. Claiming that there is some event that comes first would lead us back to the same problems with A-theoretic views highlighted in Chapter Two. On a B-theoretic picture, once the direction of the NOW has been removed, the whole notion of there being a movement through time becomes redundant.

Horwich explains “As William Newton-Smith puts it, there would be no underlying asymmetric physical relation to which the observable quality of *beforeness* would reduce... The explanation of our perception of beforeness would hinge on our temporal orientation ...” (1987, 43). This passage seems to suggest that the order which is the correct telling of events, ABC or CBA, and the direction which we call the earlier direction, will depend *not* on some *objective* feature of the universe telling us that some direction truly is earlier. Rather it will depend on our orientation in time or some perceptual fact. I agree. I have shown why on a B-theoretic view, the notion of a single objective and privileged direction of time does not exist. The B-theorist needs to do two things in giving an account of the direction of time. Firstly they need to give an account of the difference between the two directions, which I will do in §4.4. Secondly, they need to give an account of the experience of passage or objective direction in time, as highlighted by Newton-Smith (above), which I will attend to in §5.3.

I want to therefore propose that a definition of earlier and later can be given by convention only on a B-theoretic view. Since there is no real “quality [to which] beforeness would reduce” on a B-theoretic view (Horwich 1987, 43), we can adopt a direction of time by way of convention. We can decide that *earlier to later* is the correct telling of events, and that *earlier to later* is the direction in which the universe expands; the direction in which entropy increases; the direction in which various processes *fork* (see “fork asymmetry” (Horwich 1987, 201)); and so on. This means that I do accept notion (II) to an extent. I accept that the direction of time is given by content asymmetries, but only to the extent that they give us a way to orient ourselves in time. The asymmetries do not serve to pick out an *objective, privileged* direction. This is because I also accept the notion set out in §4.2.4, notion (IV), that there is no privileged direction of time. Rather, the anisotropies or asymmetries of time can give us differences between the two directions of time, as per notion (V). We can then use these objective differences between the directions of time to appeal to convention to determine which of the two directions of time we adopt as ‘the’ direction of time.

In the following sections I will discuss the thermodynamic and causal accounts of time order or time direction, and which I think is the most promising account.

### ***4.3. Entropy and the Thermodynamic Account***

In this section I do not intend to thoroughly address the thermodynamic account of the direction or order of time, I intend only to lay out what it is and present some problems for it. The objections that I present – such as the reversibility objection and what is called the problem of the direction of time – are logical objections. They show that the thermodynamic or entropic account is not logically necessary. However, this still leaves room for the thermodynamic account to be an empirical or nomological truth. I will not pretend to have decisively rejected the thermodynamic account (or even come close) but rather to have surveyed a few small but compelling problems for it, enough to have laid some doubt on it. In turn this will allow us to consider the opponent, the causal theory.

Like causation, entropy seems to have a preferred temporal direction. The second law of thermodynamics states that over time, differences in concentrations of temperature, pressure, chemical concentrations, and so on, will equilibrate, ‘spread out’ or move towards a state of ‘disorder’ (Callender 2011). Consider a tank of water with a divider in the middle, and suppose some blue dye is added to one side of the tank. When the divider is removed the blue dye will slowly spread out through the tank so that all of the water in the tank becomes tinted with blue dye. The blue dye is now paler than it was when the dye was at a high concentration on one side of the tank, because now it is in a state of disorder or equilibrium where the blue dye is mixed with the clear water.

*“Now if we wait and watch this for a long time, it does not by itself separate. (You could do something to get the blue separated again. You could evaporate the water and condense it somewhere else, and collect the blue dye and dissolve it in half the water, and put the thing back. But while you were doing all that you yourself would be causing irreversible phenomena somewhere else.) By itself it does not go the other way” (Feynman 1994 [1965]).*

Entropy displays this feature of irreversibility – or so it seems. Suppose, after removing the divider in the tank of water that we stir the tank in a clockwise direction, and the dye mixes with the water causing a state of high entropy. We might then ask: *why*, when we make the reversed action, and stir the tank anti-clockwise, or place the divider back in, that the dye does not then separate from the water and return to its state of high concentration in one corner of the tank? Despite reversing the direction in which we stir, it seems we cannot reverse the process as a whole by reversing our action. Instead, the system continues to increase in entropy as before with the dye mixing into the water. It would seem therefore, that entropy increase, or the second law of thermodynamics, is a temporally asymmetric process; it has a preferred direction in time, but no preferred direction in space.

So now that we have a general understanding of entropy, let us consider the formulation of this law. Boltzmann attempted to “reconcile the time asymmetric second law of thermodynamics with the time-symmetric laws of classical mechanics. He showed that the tendency for entropy to rise could be explained in terms of the

statistics governing particle interactions” (Dainton 2010, 48). Horwich (1987, §4.2) and Callender (1997, 2011) give an explanation of Boltzmann’s account of the second law of thermodynamics in reference to probabilistic or statistical mechanics. They explain that Boltzmann held that any microstate – the state or position of a single particle – is just as likely as any other.<sup>101</sup> For example, the microstate of a particle of dye being in the top right hand corner of the tank is just as probable as the microstate where it is just left of the middle and at the bottom of the tank. However, the probability of a macrostate – the state of the whole system, such as the tank – is determined by the number of microstates that realise that macrostate; “the probability of a macro state is proportional to the number of microstates that realise it” (Horwich 1987, 62). So while the probability of any microstate is just as likely as any other, there are far fewer combinations of microstates that realise a macrostate of low entropy and high order (such as all the dye being at one end of the tank), than there are of microstates that realise a macrostate of high entropy and low order (such as the dye and water being all mixed up).

So the entropic account of the direction of time states that the direction in which entropy increases is the direction which is to be called the future and the direction in which entropy decreases is to be the past. Any events which occur at a time in which entropy is higher than some other time at which some other events occur are thought to be thought of as the later events and at the later time, and the others as the earlier events at the earlier times. Le Poidevin (2003, 209) formulates the entropic account as follows:

*“Event A is earlier than event B if and only if the universe is, when B occurs, in a higher state of entropy than it is when A occurs.”*

But the account of entropy which we have given faces a problem that affects our ability to define time order, and direction, in terms of it. As Loschmidt (1876) and Poincaré (1889) originally pointed out, Boltzmann’s explanation also applies in reverse – it does

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<sup>101</sup> According to the “equal *a priori* probability postulate” or the “fundamental postulate” of statistical mechanics.

not say anything about *why* entropy increase should happen in one direction only, and thus it too is time symmetric.

#### **4.3.1. The Reversibility Objection**

The problem raised above – that entropy is in principle reversible – is called the reversibility objection. It claims that *if* it is more probable that entropy should decrease, given the probabilities of the micro and macrostates of a system, then it follows that given any moment in time, entropy should increase outwards from that moment in time, in both the past and future directions. “[A]ny system that at a given time is in a high (and highly improbable) state of order is likely to be in a more disordered (and more probable) condition at later time *and* at earlier times” (Dainton 2010, 49). As Callender points out:

*“Because the classical equations of motion are time reversal invariant (TRI), nothing in the original explanation necessarily referred to the direction of time ... Though [we may have] just stated the Boltzmann account of entropy increase in terms of entropy increasing into the future, the explanation can be turned around and made for the past temporal direction as well.” (2011 §2)*

Thus we are faced with the same problem we began with. The second law of thermodynamics seems to be time-symmetric, at least in its formulation, and we cannot appeal to a time symmetric law to give us an asymmetry in time that accounts for the privileged direction of time. Yet there is a further problem: while the formulation of the second law of thermodynamics is time symmetric, entropy, at least by itself and in large systems, does not reverse in time. So the formulation of entropy may be time symmetric, but entropy itself seems not to be; it is, in principle, reversible.

#### **4.3.2. The Problem of The Direction of Time**

This problem is called ‘The Problem of the Direction of Time’. The term is used to refer to the fact that while Boltzmann’s formulation of the second law of thermodynamics is time reversal invariant (time symmetric), entropy never seems to reverse in time; we never see entropy decrease. Before I continue I need to explain this claim. Entropy



certainly sometimes decreases *locally*, but not in the system as a whole. While I may be able to get a bucket of child's toys and separate the marbles from the knuckle bones, thus decreasing entropy by creating order, I have still expended energy to complete this task, and thus entropy has increased. Gold uses an example of a flame and refrigerator:

*"If entropy somewhere is seen to decrease – if for example someone is setting up the hot and cold blocks [of a steam engine] by means of, say, a flame and a refrigerator – then one can enquire what the other effects of this equipment are; it will always be seen that, if one encompasses the system as a whole that contains the flame and the refrigerator and its fuel and so forth that that system as a whole would have suffered an increase of entropy, even though some subsystem had suffered a decrease. It seems that things can only be ordered at the expense of making more disorder somewhere else"* (Gold 1965).

To make a similar point, Feynman gives an example using the Brownian Ratchet which he shows is not a case of time reversibility as originally supposed (Feynman 1964, Vol.1, Ch.46). For even when entropy may be seen to decrease in a local system, there is still an entropy increase in the system as a whole, and the local entropy decrease is part of the cause of the total entropy increase.

However, here two things should be noted. Firstly, that 'the problem of the direction of time' is not really a problem for the direction of time simpliciter, because it is a problem for entropy. It is only a problem for the direction of time if entropy is responsible for the direction of time, and therefore the observed asymmetry of entropy is a problem given the time symmetric laws. Secondly, it should be noted that the 'Problem of the Direction of Time' is often presented as a problem for the entropic or thermodynamic account of the direction of time, but I believe it is *more specifically* a further problem that the reversibility objection raises. The problem is, if entropy is reversible, as claimed by the reversibility objection to the Entropic or thermodynamic account of the direction of time, then why is it the case that entropy does not, in practice, ever decrease? Consider the following anecdote, from a play:

*"Thomasina: When you stir your rice pudding, Septimus, the spoonful of jam spreads itself round making red trails like the picture of a meteor in my astronomical atlas. But if you stir backward, the jam will not come together again. Indeed, the pudding does not*

*notice and continues to turn pink just as before. Do you think this is odd?"* (Stoppard 1993 as cited in Callender 1997).

As Callender points out "There is thought to be a serious conflict between the unidirectional process of the jam and pudding turning pink and the alleged time-symmetric laws of fundamental physics" (1997, 224). In this example, Thomasina reversed her action (at least reversed it in space), but the jam and pudding continue to mix; both time and entropy continue to go forwards. One cannot ever truly reverse entropy, for even if Thomasina invents a machine to separate jam from pudding, and Feynman does a similar thing to separate the dye from the water (in the earlier example), entropy will still increase in the system as a whole.

*"The traditional problem is not merely that nomologically possible (anti-thermodynamic) behaviour does not occur when it could. That is not straightforwardly a problem: all sorts of nomologically allowed processes do not occur. Rather, the problem is that statistical mechanics seems to make a prediction that is falsified ... "* (Callender 2011, §2)

The prediction that is falsified (which Callender refers to) is that entropy can reverse, but does not. Price presents this same problem (the problem of the direction of time) with regards to Horwich's explanation of the direction of time:

*"Horwich's version of the explanation shares an equally analogous deficit: in his case, there is nothing to explain why we don't find the reverse law, with respect to the temporal anisotropy in question. (Why shouldn't it be later rather than earlier that does the explanatory job, as it were?)"* (Price 2009, §3.9.1)

The point is that on Horwich's account we are left with the exact same problem: what explains *that* asymmetry? The objection raised by 'the problem of the direction of time' is that entropy cannot account for, or ground, the asymmetry of the direction of time if it is itself asymmetrical.

#### **4.3.3. The Past Hypothesis**

One suggested solution to 'the problem of the direction of time' – to the problem of the symmetry of the second law given the observed asymmetry of entropy – is to postulate certain boundary conditions on the past. This is called the past hypothesis. It employs a special boundary condition that claims that entropy was very low at the

beginning of the universe. The thought is that if entropy was very low at the beginning of the universe then we have an explanation as to why entropy increases over time. According to this solution, “earlier states do not have higher entropy than present states because we make the cosmological posit that the universe began in an extremely tiny section of its available phase space” (Callender 2011 §2.1). But there are, however, some objections to this solution.

Callender expresses skepticism that the past hypothesis is the correct solution. He asks “The past hypothesis is sometimes said to be independently confirmed by modern cosmology, but is that really so?” (Callender 2011 §2.1). But even if it is so, there are three possible problems. **Firstly**, is “the past hypothesis itself needy of explanation?” (2011, §2.1). Price believes it is, and claims that “the real puzzle of thermodynamics is not why entropy increases with time, but why it was ever so low in the first place” (Price 1995, 66). This would mean that the explanation for the entropic asymmetry and in turn the direction of time has not been given; it has just been moved down a level.<sup>102</sup> This objection is important because it questions the extent to which we can appeal to entropy as the explanation for the direction of time given that it faces that same problem.

**A second problem** that faces the past hypothesis is whether or not the past hypothesis truly or sufficiently explains entropic behaviour. As Callender points out, “many do not find [this solution] sufficiently explanatory of thermodynamic behaviour...that gases everywhere for all time should expand through their available volumes due to special initial conditions is, for some, incredible” (2011, §2.1).

The **third** and last problem for the past hypothesis is what is called ‘The Gold Universe’. The Gold universe employs the possibility of a ‘future hypothesis’ as well as a past hypothesis: the future hypothesis postulates the possibility that there may be *two* temporal boundary conditions. So while entropy is low in the past, at the big bang, on the Gold Universe it may also be low in the future, at the big crunch. However, if we

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<sup>102</sup> Perhaps this is a case of “Turtles all the way down” (Hawking 1988).

agree with the entropic account of time direction, we must accept that once the universe begins to contract and entropy decreases we must say that time is reversing. That would imply that the big crunch of the universe is not in the future, rather it is in the past. This is because on the entropic account we are committed to saying that lower entropy states are past states. So it is not possible for the future to have lower entropy, because lower entropy times are by definition earlier times. As a consequence, on a ‘big-bang, big-crunch’ model of the universe – where entropy is low and then high and then returns to low again (as per the Gold Universe) – we would be committed to saying that the big bang and the big crunch are one and the same event, one is simply told in reverse. This is a consequence of the entropic account, because we are committed to the claim that states of lower entropy are earlier than states of higher entropy. Le Poidevin postulates an analogous problem. “Suppose God intervened at some point to bring about a more ordered universe” (Le Poidevin 2003, 212), and we might imagine that he brought about the more ordered universe at a *later* time. On the thermodynamic account, this cannot be so, since higher order must always correspond with earlier times.

Thus we should be skeptical that the past hypothesis is a successful solution to the problems that are raised by the ‘problem of the direction of time’ against the entropic or thermodynamic account of the direction of time. I take it that I have shown that there are enough problems with the thermodynamic account that we should reject it, at least to the extent that it is not a logically necessary truth, although it may still turn out that it is an empirical truth, in the actual world. Rejecting the entropic account as logically necessary leaves some room for us to now consider a causal account.

#### **4.4. The Causal Account**

In this section I will set out what the causal account of the direction of time is, and defend it against a few criticisms, such as: how to determine the position of events in time that are not causally related to each other; how to determine cause from effect without appeal to time order (so as to avoid giving a circular account). There is also an issue about whether the causal account gives an account of the structure and

direction of *events* at times, or of *times* themselves. If it is the latter, then such an account ties in with issues surrounding Substantivalism and Relationalism, which I will address in §4.4.4. Until then, I intend my discussion to remain neutral on this issue.

The causal account is a theory which holds that causation is the ultimate asymmetry responsible for the direction of time. How might such a theory go? Well, Reichenbach “defined time order in terms of possible cause. Event A happens before event B if A could have caused B but B could not have caused A” (Dowden 2011, §3c). He claimed that the criterion for the determination of the order of events can be established using the causal relation: “If  $E_2$  is the effect of  $E_1$ , then  $E_2$  is called later than  $E_1$ ” (1958 [1928], 136). Reichenbach calls this the “topological coordinative definition of time order”. Reichenbach points out that using this definition of ‘later than’ we can also generate the definition of ‘earlier than’, as it is simply the converse of the first: “If  $E_2$  is later than  $E_1$  then  $E_1$  is earlier than  $E_2$ ” (Reichenbach 1958 [1928], 136).

There are a number of benefits of the causal account. I will cover just two here. The first is that it can explain something that the entropic account cannot. I take this argument from Dainton (2010, 50). Suppose we find a footprint in the sand on a beach. We are probably more justified in assuming that the footprint is the result of an interaction with a human foot, rather than a random fluctuation from the beach’s high entropy norm. However, as we know from the reversibility objection in §4.3.1, it is not clear why we should assume that the external influence (the footprint) happened in the past and not in the future. Conversely, on the causal theory, we *are* justified in inferring that the footprint is earlier because it is “the effect of some other event, which was its *cause*. Since we know that causes proceed their effects we conclude that the event responsible for the footprint occurred at an earlier (rather than a later) time” (Dainton 2010, 51).

Secondly, both Dainton (2010, 51) and Le Poidevin (2003, 219) point out that it seems that all of the other asymmetries can be explained in terms of causation: Why we remember and perceive the past but not the future (because remembering is an effect); we can explain why we can affect the future but not the past; we can explain why

entropy tends to increase over time; we can account for the asymmetry of explanation (because explanation usually involves citing something's cause). Some philosophers, such as Horwich (1987) would disagree. But I will not discuss this issue any further as it is beyond the scope of this project.

Let us move on to some problems. Namely, whether defining temporal order in terms of causal order is circular; whether this definition is a conditional claim, or a bi-conditional claim; whether this is truly an account of temporal structure/direction; and lastly whether we intend the causal account to be an account of the order of events or of times.

#### ***4.4.1. The Problem of Distinguishing Cause and Effect***

In order for temporal order to be given by causal order, there needs to be a fact of the matter about which, of two causally related events, is the cause and which the effect, independent of their time order. Reichenbach asks “Can we actually recognise what is a cause and what is an effect without knowing their temporal order? Should we not argue, rather, that of two causally connected events the effect is the later one?” (Reichenbach 1958 [1928], 136). However, this question should be less about whether we can *recognise* a cause and an effect, and more about whether or not there is a fact of the matter about the difference between cause and effect, i.e., whether there is a causal asymmetry. As Mellor (1995, Ch9) explains, we cannot say that the cause is the earlier of the two events, because then our theory has become circular, in which case we would be begging the question when we define time order in terms of causation.<sup>103</sup> We also cannot take a Humean account of causation<sup>104</sup> and claim that the cause is merely the earlier, and the effect the latter, of two event types that are regularly paired in the appropriate way, for then we would be explaining time order in terms of causal order, and causal order in terms of time order. Dainton argues that it is not enough to say in response to this problem that causes “make their effects happen” and that therefore

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<sup>103</sup> Note however that Hume took this option.

<sup>104</sup> I will discuss causation further in Chapter Five.

effects depend on their causes in a way that causes do not depend on their effects (2010, 52). This is because, if we can say that a cause is necessary and sufficient for its effect, then we can also say that an effect is necessary and sufficient for its cause. He gives an example of a spark which causes a fire. The spark could be necessary and sufficient for the fire, but if we consider the situation the other way, the fact that the fire did ignite guarantees that the spark occurred and therefore we can also say that the *fire* is necessary and sufficient for the *spark*. The point that Dainton is presenting here is that causation too is inherently time symmetrical, and if this is true then causal accounts of time “are at best, circular and trivial” (Dainton 2010, 52). I think that Dainton is correct that causation is symmetric in this sense; however, there is also a sense in which it is not. Certain events types always happen in a particular order (structure), and when they happen in the reverse order, time also reverses. But, I hold that there is no objective direction to causation either, and the attribution of a direction stems from our psychological perspective in time. I will discuss the idea of a conventional / perspectival / subjectivist account of the direction of causation (and time) in detail in Chapter Five, and hence I will not discuss it any further here.

#### ***4.4.2. The Problem of Events that are not Causally Related***

I am going to begin this section by giving an overview of its contents since it contains many nested objections and their replies. In this section I will firstly explain the problem of events in time that are not causally connected. Then, in response, I will explain how the causal order of some events can give us temporal order of all events. Next I will present the problem that such a reply requires there to be a fact of the matter about simultaneity. I will then present a reply to that problem, which is to employ Reichenbach’s conventional definition of simultaneity. Additionally I will explain a consequence of supposing that the temporal order of all events can be derived from the causal order of some, namely that we suppose there to be a lattice of causally connected events across space-time. Then I will explain that this poses a problem when combined with time travel, because it creates causal and therefore temporal loops. But I will propose that if we are happy to accept *local* time order then we can avoid the full force of this objection.

We do not want the causal theory to be formulated as a definition, as “*if and only if*  $E_2$  is the effect of  $E_1$ , then  $E_2$  is called later than  $E_1$ ”. This is because not all temporally ordered events are causally related, but formulating the claim as a bi-conditional would commit us to the claim that they were. If we were to hold that some event was before some other event *if and only if* the former was a cause of the latter, then we would have to admit that many events had no temporal placement with regards to each other. One event would not be before or after another if they were not causally related. In fact, it is for this reason that Mellor claims we should not *define* temporal order as causal order, but he claims that this “does not stop us *reducing* time order to causal order” (1998, 11. Emphasis added). However, we could give a definition that avoided this problem if it was formulated differently. For example: *The time of the set of simultaneous events,  $t^*$ , is earlier than the set of simultaneous  $t^\#$  events, if and only if, there is at least one event in  $t^*$ ,  $E_c$ , and there is at least one event in  $t^\#$ ,  $E_i$ , such that  $E_c$  causes  $E_i$ .*

The causal theory of time gives us an account of the temporal order of events that are causally connected, but there is a **problem**: given that not all temporally ordered events are causally related, what do we say of events that are not causally related yet surely still have a temporal order and temporal placement with regards to one another? As a result of the limited number of causal connections between events, we need to explain how the temporal order of all events, can follow from the causal order of some events.

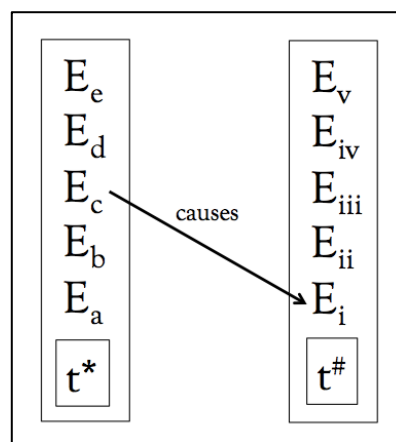


Figure 10: Events at times cause other events at other times



The **solution** to the problem is this: for any two successive moments of time, there will be a multitude of events at each of those moments, some of which will be causally connected to each other. Thus these events fix the causal order between each other, and therefore also the temporal order of the times or moments which they are placed at (as per figure 10). If it is the case that an event at  $t\#$  is the effect of an event at  $t^*$  we can then say that all events at time  $t\#$ , are *after* or *later than* all events at time  $t^*$ . From this it follows that if there is some event  $E_c$  at the time  $t^*$  which is the cause of some event  $E_i$  at the time  $t\#$  then we can say that the time  $t^*$  is before the time  $t\#$ , and also say that any event at  $t^*$  is before any event at  $t\#$ . As Mellor says,

“ ... all we need, for causation to fix the time order of any two spacetime points, and hence of  $t[t^*]$  and  $t'[t\#]$ , is – in this case – that some fact  $C$  at  $t[t^*]$  causes some fact  $E$  at  $t'[t\#]$ , thereby making all other facts at  $t[t^*]$  also precede all other facts at  $t'[t\#]$ , whether they cause those facts or not” (Mellor 1998, 113).

However, this solution faces an immediate **objection**. The solution requires there to be a fact of the matter about simultaneity. Relativity theory tells us that there is no absolute fact of the matter about whether two events are happening at the same time. This is because the time order of events is relative to the particular frame of reference of an observer (Davies 2005, 70-71). All assertions of the time of an event in relation to the time of another event will be *from the position of some observer*, and never the time of an event in relation to another event, simpliciter.

Reichenbach (1958 [1928]) and Mellor (1998) both discuss the problem of identifying simultaneous events. If two events are in the exact same place in space-time then there *can* be a fact of the matter about simultaneity, but it would mean that the two events are in fact the same one event (Reichenbach 1958 [1928], 124). But many events are distinct (non-identical) events and are spatially separated, in which case we need there to be a fact of the matter about simultaneity and about which times the events are at, in order for the causal order of some events to generate a temporal order of all events.

Supposing that Relativity Theory is correct and that it raises a problem for us with regards to simultaneity,<sup>105</sup> Reichenbach gives us a **solution**: Reichenbach (1958 [1928], §19) gives an account of simultaneity with regards to spatially separated events using the following example: suppose a light signal is sent from *A* to *B* and back to *A*. Because *A* and *B* are spatially separated we cannot know with certainty which events at *A* are simultaneous with the event of the light signal reaching *B*. However, if we assume that the speed of light is constant then we can take the time that the light took to get from *A* to *B* and back to *A* – suppose it is 6 minutes; halve that time; ask what was happening at *A* 3 minutes after the light signal left; and call that event (at  $t_2$ ) simultaneous with the light signal reaching *B*.

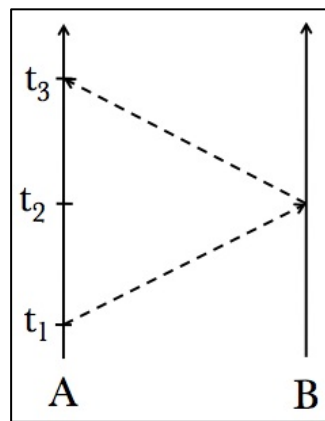


Figure 11: Reichenbach's operational simultaneity

Hinckfuss (1975, 109) gives a very similar example of simultaneity, and calls it ‘Einstein’s Operational Definition of Simultaneity’ (see figure 11). He claims that “to say that some event took place at time  $[t_2]$  with respect to our frame of reference, is to say that this event [the event of the light reaching *B*] is simultaneous in this frame of reference, with the event which is the clock at [*A*] reading  $[t_2]$ ” (1975, 109). Both Reichenbach and Hinckfuss acknowledge that this is not a definition of *absolute* simultaneity, as one cannot be given, but it is a *conventional*, *coordinative*, or *operational*

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<sup>105</sup> As explained in §2.7, we now know that relativity theory may not be correct, as it makes predictions that not compatible with quantum theory, and vice versa. Thus we should not make metaphysical inferences from some, as yet, unverified theories in physics. For more on this, see Monton (2011).

definition of simultaneity. There is no real fact of the matter as to which events are *absolutely* simultaneous. In light of all this, Reichenbach presents two criteria for simultaneity: (i) the exclusion of causal connection between the two events, and (ii) any two events which are indeterminate as to their time order (Reichenbach 1958 [1928], 145). Let us accept this account of simultaneity.

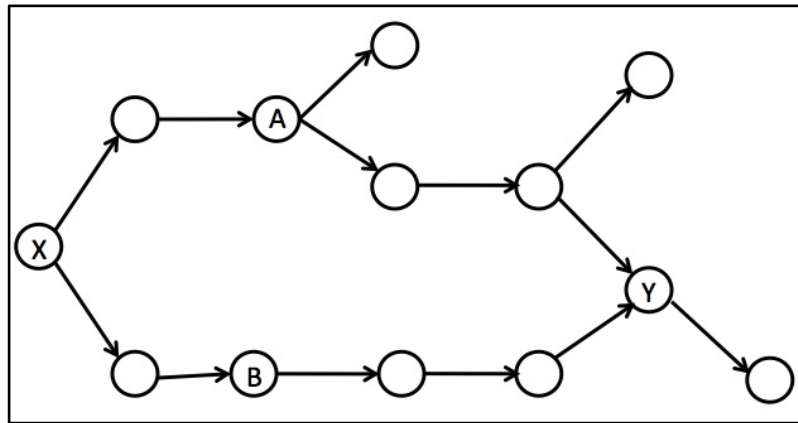


Figure 12: Lattice-like causal chains

One consequence of holding that the causal order of some events gives the temporal order of all events is that it follows from this that all events are somehow causally connected to all other events, and there are no causal chains that are unconnected. Suppose that the causal chains of the world are like a lattice or a weave, and that where some event has multiple effects the causal chain branches, and where some event has multiple causes then multiple chains converge into one. Figure 12 shows parts of two causal chains (that began as one) separating and then later converging. Once we have this lattice of causal chains we can appeal to shared causal chains to give us betweenness and simultaneity relations between events that are not causally connected – similar to the cases above of Reichenbach’s light signals. For example, suppose we want to know the order of two events, A and B, which are not directly causally related. If they both have a shared cause X and a shared effect Y, then we can make a guess and say they are approximately simultaneous (see figure 12). Alternatively, suppose there is a world where A has an effect P, and P is a cause of B, then we can say that P is between A and B, which gives us an order with regards to A, B, and P. We perhaps cannot generate information about which events happened at exactly the same time points as which

other events – we will still have some issues of simultaneity as previously discussed. But we can nonetheless generate betweenness relations (relations of order) and from that labelled axis, we can generate before and after relations (relations of direction).

However, if we accept that lattice-like causal chains connect all the world's events, then we come into a problem when we combine this with time-travel. This is because if all events are causally connected then any time-travel into the past will mean that later events are also earlier events, and we end up with a causal (and therefore temporal) loop, which complicates our ability to generate earlier than, later than, and simultaneous relations between events, since some events will be *both* earlier and later than others.

The solution to this problem is to say that we are only giving an account of *local* order of space-time. This is also touched on by Le Poidevin (2003, 223) as a solution to the problem of non-causally-related events. Such a reply postulates that while, in the bigger picture, there is no fact of the matter about which events are earlier and which are later (given the loop), we can still give a local account of the direction of time based on the direction of causation in that region. We can also appeal to the isolation and encapsulation requirement that I postulated in §1.10 (which I will use again in §5.1). This requirement will mean that any region of space-time which is exhibiting 'backwards' causation is causally isolated from surrounding regions; therefore we do not have bizarre causal interactions between the two regions which have oppositely directed causation and time. This allows us to avoid further complicating the issue of the direction of time. As such, I feel we should be happy to 'bite the bullet' of local causation and therefore local time direction.

#### **4.4.3. *Substantivalism, Relationalism and The Causal Theory***

Here I want to say something about Substantivalism and Relationalism. To put it simply, Substantivalists hold that space and time are entities (or is an entity) above and beyond the objects and events in space-time. Substantivalism sees space-time as like a container in which objects and events exist. Relationalism, however, holds that there is

nothing more to space-time than the objects and events in it, and the relations that hold between them (Dainton 2010; Norton 2011; Schaffer 2009). I do not intend to get into the details and implications of these two views in any real depth. My aim here is just to say a little on how I want my thesis to remain neutral on this issue.

It might be said that a reductionist account of the direction of time – such as an entropic account, or the causal account that I am giving – does not sit well with Substantivalism (this is held by some, such as Smart (1969) and Von Bretzel (1977)). This is because a reductionist account seems to imply that the underlying temporal structure of space-time reduces to causation (or entropy on a thermodynamic account). That is, it might be thought that giving a reductionist account, since it is giving us the ordering of events and therefore the ordering of times, is therefore giving us the basic structure of space-time. As in, the basic structure of space-time is determined by the causal ordering of events in space-time, and thus space-time itself reduces to those causal orderings – which is what a relational picture of space-time holds. The relational picture holds that there is nothing more to space-time over and above the relations that hold between its contents. If we hold that the basic ordering or structure of space-time temporal points (i.e. moments of time) are given by the causal relations, then it might look like we are necessarily giving a relational account of space-time. Tooley explains the worry here:

*“[T]o accept an absolute view of space and time is to hold that space and time might exist even if there were no physical objects or events, while, on the other, to accept a causal theory of time is to hold that at least some tenseless temporal relations are analysable in terms of causal relations” (Tooley 2000, 261).*

However, I do not think it is necessarily the case that a reductionist account of the direction of time commits us to a Relationalist picture, as opposed to a Substantialist one. Let me explain why I think it is wrong to suppose that a Relationalist picture must follow from a reductionist account of the direction of time.

Super-substantivalism, a type of Substantialist picture, holds that space-time is a thing which has parts such as places and times, or hybrid place-times (Schaffer 2009). Such parts have properties such as being of certain sizes, having certain sub-regions, and also

standing in various relations to other parts or regions of space-time. However, it may be the case that none of the relations between those parts of space-time are the earlier-than / later-than relations which gives the direction of time. In that case, we would need to look at the content asymmetries in order to find the earlier-than / later-than relations. This is why the distinction between asymmetries of time *itself* (asymmetries *of* time), and the *contents* of time (asymmetries *in* time) is important. If one is a Relationalist then the two kinds of asymmetries – asymmetries *in* time, and *of* time – are one and the same, because time just is its contents. However, if we take a Substantivalist picture of time then we are to accept that asymmetries *of* time and *in* time are two distinct kinds. In a Substantivalist world where none of the relations of space-time itself gives us the direction of time, it may still be the case that some region of space-time has generally lower entropy, or has certain causal features, which makes it different from some opposite region, *in virtue of* what it contains, rather than what it is. We can then pick out some side or region of space-time as the ‘earlier’ region and the opposite region as the ‘later’ based on these features. Therefore we can be Substantivalists, but still hold that the direction of time derives not entirely from the intrinsic structure of space-time, but also from the particular distribution of contents. If we had the same space-time structure with a different content, then the direction of time might be different, or time might have no direction at all (if there were no asymmetries in the distribution of contents of space-time). This is how substantivalism and reductionism about direction would be compatible.<sup>106</sup>

Consider this passage from Horwich:

*“I suspect that the real source of Grünbaum’s weak criterion of anisotropy [the notion that de facto anisotropies are sufficient] is his rejection of absolutism with respect to time: he denies, like Leibniz does, that time is any sort of substantival entity over and above the phenomena that are located in time. This position leads him, mistakenly I*

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<sup>106</sup> My gratitude goes to Antony Eagle for discussing with me the relationship between Super-Substantivalism and reductionist accounts of the direction of time. (Personal communication, 2013).

*think, to treat the question of whether time is isotropic as the question of whether the ordering of states of the world is isotropic*" (Horwich 1987, 47).

Horwich assumes that reductionism about the direction of time and Relationalism go hand in hand. He holds that because Grünbaum rejects substantivalism, Grünbaum is lead to hold that asymmetries in time can account for the direction of time. However, as I have just explained, contra Horwich, it is possible for one to hold a Substantivalist picture and also hold that the direction of time can be accounted for by content asymmetries of time. Even if Grünbaum had been a Substantivalist about space-time, he still may have held this supposedly 'weak criterion of anisotropy'.

Another possibility, held by Tooley is that a causal theory and substantivalism can be made compatible by showing "that it is possible for spatiotemporal regions to stand in causal relations to one another, for then the logical possibility of a world devoid of matter poses no objection to a causal theory of time" (Tooley 2000, 262).

Let us consider another way to support this possibility. In §4.2 I examined the relationship between the direction of time and temporal asymmetries. Unless there are some asymmetries or features of time *itself* that give rise to some feature *in* time which in turn gives rise to the direction of time, then it follows that the structure of space-time, such as an asymmetry in space-time itself, may not account for any asymmetries *in* time. To explain further: we can imagine that time itself might be asymmetric (such as Price's world in which time is finite in one direction and infinite in the other, as referred to in §4.2.2), but that such a feature of time might have no impact whatsoever on any of the contents in time nor give rise to anything that would be perceived as anything like a passage or direction of time. Therefore, I do not think it is the case that Grünbaum's position is a 'weak criterion', as Horwich claims. Rather, I hold that once we have rejected the notion of an objective moving now, then appealing to temporal asymmetries is the only option available to us to ground the notion of the direction of time. It is still possible that there exists a space-time manifold – as per the Substantivalist picture – yet, unless the asymmetries *of* that space-time manifold cause or give rise to some kind of asymmetries *in* time, then they do not affect us or our experience of the passage and direction of time. Therefore, while asymmetries *of* time

may very well still exist, they do not seem to be a very likely candidate for what we are referring to when we refer to this experience of a direction of time.

Even if we are Substantivalists, we can still hold that some asymmetry, such as causation or entropy, grounds the direction of time. We could in turn hold that some feature of space time itself, some structural asymmetry, is what grounds the asymmetry of causation. All I am proposing in this chapter is that *it is the asymmetry of causation that grounds the direction of time*. There may or may not be some space-time structure that grounds causation, but that is an issue of Substantivalism and Relationalism which I intend to remain neutral on.

#### **4.5. Chapter Conclusion**

In this chapter I have outlined issues surrounding the direction of time, as well as surrounding the relationship between temporal asymmetries and the direction of time. I have stated that since we have rejected the notion of an objective moving NOW, as in Chapters Two and Three, we should look elsewhere for an account of the direction of time, such as in content asymmetries in time (see §4.2). I have concluded §4.2 by claiming that asymmetries in time ground the direction of time (§4.2.2), but I have also claimed that (on a B-theoretic account, at least) the asymmetries can give us no *privileged* direction of time (§4.2.3) in the sense that the A-theorists might wish for. Nevertheless there are directions of time (§4.2.5) and we can assign, by convention, one of those directions to be ‘the’ direction of time. I will establish this further in Chapter Five when I discuss causal asymmetries, backwards brains, backwards causation, and why the reversibility objections that apply to the entropic account do not succeed against the causal theory.

After considering the relationship between the direction of time and temporal asymmetries, I outlined the thermodynamic account of the direction of time and why I think there are some problems with it. Next, I gave an overview of the causal theory of the direction of time, which grounds direction in the asymmetry of causation. I do not claim to have outright rejected the entropic account nor definitively shown the causal



account to be correct. Such an endeavour would be far beyond the scope of this thesis. What I have shown is how the causal theory can be a workable theory of the direction of time. In the following chapter, I will show how the causal theory applies to time travel to produce an account of time travel that fits well with the notion set out in Chapter One, and produce a story which accounts for a number of our intuitions about time travel. We should now move on to Chapter Five with the intention of applying the causal theory from §4.4 and the ideas about content asymmetries from §4.2 to the notion of time travel established in Chapter One, for some interesting and enlightening consequences.

# 5 Time-Travel, Causation, and Memory

I should begin this chapter by making it explicit that I endorse a view very similar to Huw Price's in which there is no *objective* causal or temporal direction; instead direction is a "projection of our own temporal asymmetry as agents" (Price 1996a, 467). However, I do want to allow that there is objective causal *asymmetry* (and hence temporal asymmetry, since the temporal reduces to the causal). I hold that there are objective facts about the distribution of events in space-time, and the causal relations that hold between them, and there are objective facts about the asymmetries of that relation. But what there is not, is an objective causal *direction*; there is no objective fact that the causal relation 'goes from' cause to effect, rather than from effect to cause. Of course, there are asymmetries in the causal relation: probability boosting asymmetries, entropic asymmetries, counterfactual asymmetries, and so on. But I endorse the view that there is no *objective* direction.

Now, it might be said that if there is objective asymmetry then that would produce direction; that direction supervenes upon asymmetry. However, in Chapter Four, I explained why this is not *quite* so. If we understand direction as something additional to asymmetry, as a way to *privilege* one of the two directions of time, then asymmetry does not give us direction. In Chapter Four I explained that temporal and causal asymmetry at most gives us directions (plural); something extra is needed to select one of these two directions in time as the *privileged* direction. I explained in §4.2 there is no non-arbitrary way to choose one of those two temporal and causal directions to be *the* direction. So, given this, I take a position like Price does: I hold that the selection of one of those two directions as *the* direction of time is a matter of our perspective as agents in time. This is known as a 'subjectivist' or 'perspectival' account of the direction of causation (and hence time). Note though, that despite rejecting objective direction, we can still talk of a direction of time, but we must understand that it is a *conventional*

feature of time, assigned to time by our perspective as agents in time, and is not an *objective* feature. When appropriate, I will signify which way of understanding the notion of direction of time that I am referring to, by talking of an *objective direction of time*, and of a *conventional direction of time*. I will do the same in the case of direction of causation. Where I do not signify which I mean, I am using the term to refer to either; I am intentionally leaving it ambiguous.

I take it that this conventional account of direction has been sufficiently motivated and outlined in the previous chapter (Chapter Four). This chapter will seem somewhat unsupported by references to earlier philosophical research as I have not found much work that discusses reducing the *direction* of causation, and hence time, to a merely psychological phenomenon. There is Price's work of course, but his is primarily focussed on the perspectival account's compatibility with theories in physics (such as quantum mechanics), and earlier versions of this idea were presented as accounts which focussed on *agency* (Price 1991; Menzies and Price 1993), rather than an agent's perspective and position in space-time. The focus of my application of this perspectival account is somewhat different. Therefore, I will not be defending Price's perspectival account against, for example, criticisms like Dowe's (1996) which hold that such an account is not compatible with certain features of quantum mechanics. Instead, this chapter will combine three things. It will combine consequences of the conclusions from Chapter Four, with this perspectival or memory-accumulation account of direction, and with the time-travel definition from Chapter One.

In this chapter, in §5.1, I present a case in which backwards time-travel need not involve backwards causation. This is because on a causal theory of time we can say that when the causal processes reverse, as they do in the time machine during backwards time-travel, time also reverses – since time reduces to causation. Thus there is no objectively backwards causation involved in backwards time-travel. There is only *oppositely* directed causation.

Following that in §5.2 I consider a *causal version* of a reversibility objection. A reversibility type objection is classically given against thermodynamic theories – theories

which ground the direction of time in entropy – and shows (or objects) that the notions of the direction of time and of entropy can come apart, and that therefore the thermodynamic account is, at least, not a logical truth. I attempt to address the possibility of a *causal* reversibility objection, and show that time and causation cannot come apart. This follows on from §5.1 which looked at the time-travel scenario that I take to be an instance or example of the reversal used in a causal reversibility objection. The inability of the direction of time and the direction of causation to come apart, as per my interpretation, shows that there is a logical (not just a physical or nomological) connection between time and causation.

Next (in §5.3) I present a sketch of how and why we might *experience* a passage of time given that we are rejecting the notion of objective passage (as B-theorists), and given that we are adopting Price’s perspectival or conventional account of the direction of time and causation. I claim that the way in which our memories accumulate is the key feature to use in explaining why we *experience* passage. I also give a little sketch of how such an account might work. While there is some literature that loosely ties in with this I will not be looking into it.<sup>107</sup> I do not think it is essential to my project to cover this in any depth, only to say something about what kind of theory would be compatible.

I then go on to discuss (in §5.4 and §5.5) Dummett’s (1964) Backwards-Brains case: the idea that memory and prediction would be impossible in a world in which external causation ran the opposite way from our world, or in a world in which agents’ memory accumulation ran the opposite way from our world (i.e. the agents in either world would experience causation and time as running what we would call backwards). I

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<sup>107</sup> See Callender (2008), Dainton (2010 Ch7), Mellor (1998 Ch4, §6.4, §11.2) Oaklander (1993), Paul (2010), Prosser (2007), Roache (1999) and Russell (1915) who discuss this. Although some of the discussions by these authors are less about the psychological features of temporal experience – which I am focussed on here – and more about the truth-makers of tensed thoughts or beliefs. In that way, some of these discussions are analogous to the discussions of the tenseless truth-makers of tensed sentences; for example, Dyke’s token-reflexive account (2002) and Mellor’s date-time account (1998 Ch2, Ch3).

show, contra Dummett, that the notion of backwards-brained people<sup>108</sup> is not inherently contradictory – although it may be contrary to laws of physics that are anything like ours. I must do so because the *logical* possibility of backward-brained people is a consequence of pinning the *direction* of causation (and hence time) to the perspective of agents (as per Price), and to the way in which their memories accumulate (as per §5.4 to §5.7).

In §5.6 I remind the reader that although we are speaking about causation as ‘going’ in some direction rather than its opposite, this is a matter of convention and illustrative ease only, and that there is no direction in which time or causation *objectively* goes; there are only facts about the asymmetry of the causal relation. I outline this asymmetry briefly in §5.7. I also remind the reader that on my account, time can be local. In §5.8 I say something about what it means for time to be local. Local time was established in Chapter One’s discussion of isolation, encapsulation, and exemption, as well as in Chapter Four, and in §5.1 and §5.2.

### ***5.1. Backwards Time-Travel without Backwards Causation***

In this section I aim to tell a B-theoretic, backwards time-travel story which I believe can be said to not involve backwards causation, in any objective, non-relative sense. I do so by showing how an appeal to a particular understanding of a causal theory of the direction of time allows us to say that the direction of causation and the direction of time do not come apart. Therefore the time-travellers who appear to be going backwards in time from our point of view, are from their own point of view going forwards, not only with regards to causation, but also with regards to time. Thus, on such an account of time-travel, the direction of causation and the direction of time

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<sup>108</sup> Note however that if the direction of time is given by the perspective of agents then agents cannot be perceiving things backwards in time. Instead, it is that their brains and mental activity is backwards *from the perspective of* ‘normal’ directed people. Who are the backward-brained people, and who are the forwards- or normal-brained people is relative. I will discuss this in full detail in §5.4.

correspond, and so causation is not going backwards in any objective sense. I take this to be an interesting consequence since it is normally thought that backwards time-travel involves backwards causation.

Suppose we tell a time-travel story in which the backwards time-travellers inside the time machine can see what is going on outside of the time machine, as if, in true Wellsian Style (1895), they are travelling through all the intervening moments of time. Harrison (1971), amongst others, tells such a story, and I choose Harrison's story only because I am fond of tea-drinking time-travellers. In his story, Harrison supposes that the time-travellers take 120 minutes (personal time) to travel back in time 120 years (external time)<sup>109</sup>, from 1971 to 1851, and as they do so, Harrison's time-travellers decide, at the beginning of their journey, to make a cup of tea (assuming such facilities are available inside their 'suped-up'<sup>110</sup> time machine), and then drink it.

I take it to be generally agreed that we do not suppose that during their journey the time-travellers experience themselves un-making and un-drinking their tea: with the tea coming up out of the oesophagus into the cup, the milk coming out of the cup into the milk container, the tannins in the tea un-mixing and going back into the teabag, and then the hot water flowing up of the cup and into the kettle!

I think we can all agree that to the time-travellers, their experience of time, causation, entropy, memory, and indeed tea-making – at least with regards to the goings on *inside* the machine – are much like any other causal interactions with one's surroundings on any other normal, non-time-travelling journey. (Note however, that this is not simply a matter of the time-travellers' experiences. There are objective facts about the goings-on inside the time machine, and they would be so even if the time-travellers did not

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<sup>109</sup> Personal and external time as per Lewis (1976).

<sup>110</sup> Dictionaries disagree as to the correct spelling of the word as “suped”, “supped”, or “souped”. It seems this is because they disagree as to the origin of the expression. As synonymous expression would be to say that the time machine was ‘kitted-out’.

experience them – if they were asleep or unconscious – or if our time-travellers were not conscious or sentient creatures at all, but rather pot plants or a lasagne).

Of course, to the non-time-travellers living outside of the time machine, supposing that they can observe the goings-on inside the machine, it will certainly look as if those inside the machine are un-drinking and un-making their tea. And, given that in Harrison's story the time-travellers experience 120 minutes of personal time during 120 years external time, we can infer that the outside would observe a *very slow* un-making and un-drinking of tea.

So both the time-travellers, and the non-time-travellers, see the others as going in reverse. But who is correct? Who is going in reverse, and who is going 'the right way' in time? You might be inclined to say that the people in external time are going in the right direction, and the time-travellers are not – after all, they are time-travellers (partly) in virtue of their movement in the abnormal or wrong direction of time.<sup>111</sup> But I do not believe the answer is quite as obvious as we first might be inclined to suppose.

As an aside, I do not think that such an account of time-travel – one in which those in the machine and those outside can observe each other – is a plausible one. This is because it seems to complicate the matter to expect that the time machine is causally isolated from the world, to the extent that causal processes in it go in the opposite temporal direction from the external world, whilst also supposing that those inside and those outside can view each other. Viewing, after all, is a causal process which would involve light reflecting off objects in the time machine and into the eye of the outsiders, and vice versa, with light reflecting off objects outside of the time machine and into the eyes of those inside. I take this to be problematic. This is why I hold the 'isolation and

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<sup>111</sup> I take it to be the case that their movement in the direction opposite to the standard direction of time is what gives rise to the discrepancy between personal and external time that is considered the (or at least a) defining feature of time-travel. Admittedly, in a forwards time-travel story it would not be the time-travellers' movement opposite the standard direction of time that would cause the discrepancy, so a different story would need to be told in the forward time-travel case.

encapsulation' requirement from §1.10, although someone may be able to give an account of how such interaction could be so. Regardless, I shall not concern myself further with this worry.<sup>112</sup>

Suppose now, that one takes a causal theory of the direction of time. In fact, it need not be a *causal* theory; it would be possible to use some other theory of the direction of time, such as a *thermodynamic* theory, so long as such a theory contained the consequence crucial to my story, namely that the direction of causation is inherently bound up with the direction of time, with the consequence that the two do not come apart. So taking a causal theory is perhaps not *necessary* for my story, but let us hold to a such a theory for ease of illustration.

As a result, we could say one of two things about our time-travel story. *Firstly*, we could say that there can be no time-travel on a causal theory of the direction of time, because there could be no backwards causation if we accept the commonly held position that backwards causation is a requirement for time-travel. Let us take a few moments to consider this claim.

It is generally taken that backwards time-travel, i.e., time-travel into the past, involves, indeed *requires*, backwards causation. I will now briefly list a few works that hold this. In one of his time-travel papers, MacBeath states that “if it is a necessary truth that an effect cannot precede its cause, then my [time-travel] story is indeed impossible” (1982, 413). In theirs, Keller and Nelson point out that “it has been argued that the backwards causation that time-travel (into the past) requires, is impossible. Some claim that the concept of causation itself rules out any backwards causation” (2001, 340), while Monton asserts that “When time-travel occurs, however, backwards causation occurs” (2009, 55). And in his text book, Garrett affirms that “Time-travel into the past

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<sup>112</sup> Tooley (2013 manuscript) gives an example where there are two regions of space (space-time) in which causation goes in opposite directions. This is in many ways analogous to the time-travel story told here. But Tooley goes a step further and removes the barrier between the two worlds. I do not do this. I only want to remove the barrier between the isolated, encapsulated, and exempt regions during the departure and arrival events.



necessarily involves backwards causation” (2011, 108). These are just a few examples, but I will take it to be generally held that time-travel into the past is thought to involve backwards causation.

It is worth considering momentarily what we mean by backwards causation. Monton describes backwards causation as taking place when “an event  $c$  that occurs at a later time has a causal influence on an event  $e$  that occurs at an earlier time” Monton (2009, 55). While Faye (2010) holds that backwards causation is where “the temporal order of the cause and effect is reversed with respect to normal causation, i.e. there may be cases where the effect temporally, but not causally, precedes its cause”. Smith understands backwards causation to be “causation where the effect precedes its cause” (2013, §3.1). I take backwards causation to be where the direction of causation goes opposite to the direction of time. I hold that all three understandings of the notion of backwards causation presented here are compatible with my own account. But note however, that some of them seem to conflate the notion of backwards causation with that of causal loops. It may be possible for there to be backwards causation without causal loops, as argued by Monton (2009). At the very least, the two concepts are distinct. Hence I prefer my notion of backwards causation, as it does not necessarily imply causal loops.

So that being said, let us return to the *first* thing we could say about time-travel on a causal theory of time, namely, that there could be no backwards time-travel because there could be no backwards causation. This is because, if the direction of time is given by the direction of causation, and if the two cannot come apart, then causation cannot go in the direction opposite to the direction of time. Thus there cannot be backwards causation on a causal theory, and therefore there cannot be backwards time-travel.

Note however, that not all causal theories hold that the direction of time and the direction of causation cannot come apart. Some causal theories hold that the direction of time is given by the direction of the *majority* of the causal chains or arrows, and hence there can still be causal eddies which are *not also* temporal eddies, and that causation can go one way without time also going that way. So here I take it that I am considering a particular kind of causal theory of the direction of time. Specifically, one

in which a local causal eddy implies a local temporal eddy. A causal theory in which causal arrows in some region fix the temporal direction *in that region*, as opposed to a causal theory in which the direction of time is given by the majority of causal arrows, ignoring local causal arrows. I am not going to argue for this type of causal theory here, because I believe that this has been significantly discussed in Chapter Four (§4.2). Here my aim is to show an interesting consequence of adopting such a theory and combining it with time-travel. The interesting consequence being that in such a framework, backwards time-travel need not involve backwards causation, contrary to general philosophical opinion.

The *second* thing we could say (and the one that I endorse) is that when causation (apparently) goes backwards, as in the case of the tea-drinking backwards time-travellers, time does too. This would mean that within the time machine (i.e. locally), the direction of causation and the direction of time correspond (or, one reduces to the other<sup>113</sup>). When we talk of backwards causation, I take it that we mean that the direction of causation is opposite to the direction of time (we could rephrase this to fit with Monton's and Faye's understanding), but in my story it is not the case that causation and time come apart and so they cannot be going in opposite directions. The result of this is that there is no backwards causation in the backwards time-travel case because, in any localised region, the direction of time and the direction of causation do not come apart, but rather they correspond. This is due to the view of time and causation that we have adopted, namely, a causal theory of the direction of time that allows for localised causal direction and hence localised temporal direction.

Of course, we could counter this conclusion (the second: that time and causation correspond) by assigning one of the directions to be *the* direction of time – probably the direction in which the majority of causal or temporal arrows go – and therefore we can say that relative to *the* (privileged) direction of time, causation within the time machine does go backwards. However, not only is this not the type of causal theory I am

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<sup>113</sup> A reduction is a stronger claim than a mere correlation. For our purposes, we only need there to be a correspondence, regardless of whether that is a result of a temporal to causal reduction or not.

employing in this paper, but this is also not an *objective* sense in which causation is going backwards; it is merely backwards *relative* to the majority of temporal arrows, or to the conventional direction of time – or however we have chosen to assign privilege to the direction that we call *the* direction of time.

Now it might be said that I have not said anything new here: that we have always agreed that causation and other ‘content asymmetries’ appear to go forwards to the time-travellers in the time-travel story, and that whether or not we grant that time is also going in the same direction will simply depend on which theory of the direction of time we subscribe to (and, if we allow for the direction of time to be a local rather than fundamental matter). I agree. I do not take *that* part of my story to be original. However, I believe that what has *not* been made explicit in the literature is that such a telling of a time-travel story (i.e., backwards time-travel combined with a causal theory) allows us to say time-travel does not involve backwards causation *per se*, but at most, it involves backwards causation *relative to a particular frame of reference*.

There are certainly hints of such ideas in other philosophers’ works – for example, MacBeath and Sider. MacBeath (1982) recognises that the notion of the direction of causation, or the order of cause and effect is based on a certain assumptions about time, namely that time goes in a certain direction.

*“The proposition that an effect cannot precede its cause is thought to be a necessary truth because it follows necessarily from an assumption about the nature of time which is usually regarded as unquestionable... the assumption about the nature of time... would be that time flows uniformly in one direction.”* (MacBeath 1982, 413).

But in Chapters Two and Three I rejected the notion that time flows, and in Chapter Four I left open the possibility that time and its direction can be localised.

It seems to me that Sider also recognises that the direction of time is tied up with this issue, given that in his paper he argues, amongst other things, that the Presentist cannot make use of the causal ordering required to employ the personal and external time distinction, because they are committed to a certain view of the direction and passage of time (Sider 2005). Sider claims that it

“is possible to deny the possibility of backwards causation on the basis of i) an anti-reductionist theory of the direction of time, and ii) a reduction of causation to, among other things, the direction of time.” (Sider 2005, 335, footnote).

In Chapter Four I have endorsed reductionism about the direction of time to the direction of causation. We now begin to see that such an endorsement has implications that help satisfy the requirements of time-travel stories.

So, while others, such as MacBeath and Sider, have recognised the connection between backwards causation and theories on the direction of time, I take it that no one has made explicit the outcome that I am discussing here. I take it that the possibility of rejecting backwards causation in time-travel stories is a novel and interesting consequence of a causal theory of the direction of time.

## **5.2. A Causal Version of the Reversibility Objection.**

In §4.3.1 I presented what is known as a reversibility objection to the entropic or thermodynamic account of the direction of time. The objection puts forward a counterexample to the thermodynamic theory of the direction of time by presenting a case where entropy increase goes in reverse, yet we would not want to claim that time also does (or, time goes in reverse and entropy increase does not<sup>114</sup>) and hence appeals to our intuitions to get us to admit to the logical separation between the direction of time and the direction of entropy increase.

I now want to consider a *causal* version of the reversibility objection, and explain why it does not succeed in separating the direction of *causation* from the direction of time, or vice versa.

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<sup>114</sup> I hold that these two are equivalent. But the point that I am making is simply that time and entropy are going in directions opposite one another. There is no fact of the matter about which one is going in the correct or normal direction and which one is the backwards case. In §5.6, I will reiterate that I reject the idea that time or causation ‘goes’ in any direction at all.

Consider a case in which causation is running in (what we might call) a backwards direction in some localised region of space-time. Putting aside the problems associated with viewing such a region and how the causal processes of viewing would work,<sup>115</sup> suppose we can look across into such a region of space (or space-time) and observe all the events in that region as if they were running backwards. (This is similar to Shoemaker's (1969) story, except that time does not stop in the other region; instead causation appears to run in reverse.) People in the 'backwards' region would be un-drinking their tea, un-typing their emails, walking backwards, 'forgetting' things that had (from our perspective) happened in their past, and so on. A causal chain in their region would seem to be running backwards: *E, D, C, B, A*. Even the mental events of the inhabitants of that region seem to run backwards: *Z, Y, X, W, V*.

Now, we might want to say that this is a good contender for a case of backwards causation – of the direction of time and the direction of causation separating – because everything is (from our perspective) running backwards, and even the things that the agents in this region 'remember'<sup>116</sup> are the things that happen in (what we would call) the future. We might say of such a case that causation was going backwards because *we see* all actions and events as going backwards, whilst we believe that time is still going forwards, and the justification for this thought would be based on our own experience of our region of the world. However, given that the agents in this region have knowledge of events in one direction and not in the other, and they anticipate and predict events in one direction and not the other, and so on, what reasons do we have for thinking that the agent remembers the *future*, and not the *past*? What reasons do we have for thinking that the past is constituted by the events that lie in one direction and not the other? What reasons do we have for thinking that this case (or any) illustrates a separation of time and causation, and hence constitutes a reversibility objection to the

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<sup>115</sup> If we take this to be a time-travel story like that from §5.1, then viewing this region would not be possible because of the encapsulation and exemption feature, as set out in Chapter One. Tooley *would* allow for viewing, for example: his golf case (2013 manuscript, §13.4).

<sup>116</sup> In section §5.5 I will examine the usage of the notions of memory, remembering, prediction, and retro-diction when used in the non-standard temporal direction, and when the notions of past and future are time-reversed.

causal theory)? I will examine two reasons that might be given, and then reject them both. I will therefore conclude this section with the claim that there is no separation of the direction of time and of causation.

**One reason** would be that we might have postulated some kind of objective direction of time, or some kind of external hyper-time, which has an arrow that overlays this region (or both regions) and shouts “I am *the* direction of time. All arrows going opposite me are therefore going backwards”. Yet this type of account of the direction of time is one in which the direction of time is given, not by content asymmetries, but by either the direction of the objective moving NOW, or by some intrinsic, unanalysable asymmetry of time (as per Maudlin 2002, 2007). However, this type of account of the direction of time has been rejected in Chapters Two and Four for the reasons given there, and therefore we can reject this first option as a possibility.

**A second reason** is that we might have postulated that the first region is somehow temporally privileged: that whichever direction that time is going in, in that region, sets the direction of time for the rest of space-time (this would be an understanding on which time is not local). And, that this is the case regardless of the distribution of the contents of space-time in those other regions. This would allow us to say objectively that the people in the backwards region really are going backwards, against the direction of time, and they are doing so regardless of the fact that the temporal symmetries in their region of space-time tell a different story (i.e., it would suggest that the direction of time is going the same way as the temporal asymmetries). However, other than the possibility of an intrinsic direction of time as postulated in the first reason, I can see no reason to think that the first region (or any region in some possible world) would be temporally privileged in a way which meant that direction of time in that region decided the direction of time throughout the rest of space-time.

Without some fact of the matter about which of the two regions is ‘going’ in the correct direction (as there would have been had we adopted either of the two options above), we can see that the two regions are time-reversed equivalencies. They are mere time-reversed opposites when compared to each other. Taken alone, they are directly

equivalent or isomorphic. In fact, this case is exactly analogous with the time-travel story from §5.1.

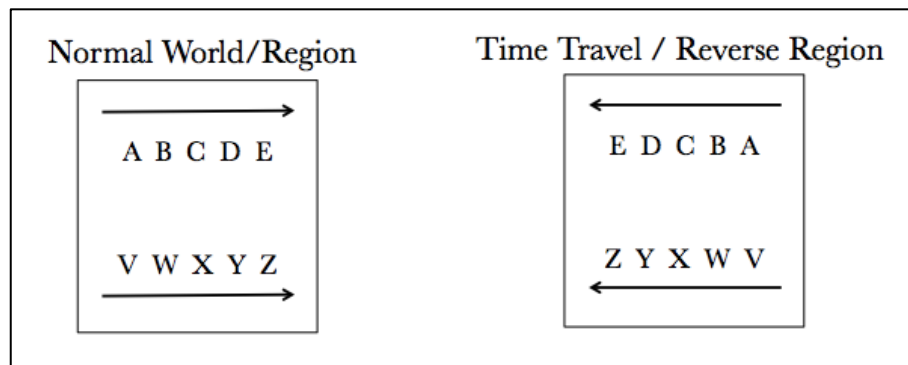


Figure 13: Directions in the normal world/region compared with in a time-travelling region or reverse world.

Without the two reasons postulated above, which set some objective standard of the direction of time, I can see no reason to say that *causation* is going in one direction in some world or region, while *time* is going in the other. Time *just is* going in the direction in which causation is going. It just is going in the direction in which the inhabitants believe it is going (limited to that region), in the direction in which their memories accumulate, in the direction in which they anticipate, and so on. Consequently, we can say that it is not possible for there to be a causal version of the reversibility objection because it is not possible for time and causation to come apart. This is because, after consideration of earlier chapters' conclusions and the two options above, we have ruled out the possibility that the direction of time could be going one way, while the contents of time going the other. This is not ruled out on all views of course. On views such as Maudlin's, in which the direction of time is an objective, global and fundamental part of reality then the direction of causation and contents in time could conceivably come apart from this "intrinsic, unanalysable" direction of time. But for us, when it appears as if causation has reversed locally, as in the time-travel case, we are *not* justified in saying that there is a global fundamental direction of time, and that therefore causation is running backwards, opposite to the direction of time. We are not justified, because we are working with a B-theoretic account – an account on which there is no global fundamental direction of time – as established in Chapters

Two and Four.<sup>117</sup> Therefore, a complete reversal is equivalent to no reversal at all, just like in the time-travel story from §5.1. Consequently, there can be no reversibility objection to the causal account, because the proponent of the causal theory is perfectly happy to ‘bite the bullet’ as it were, and say that time reverses when causation reverses.

A consequence of holding the view that time reverses when causation does (since the direction of time and the direction of causation always coincide) is that it could allow for localised regions of time direction, and thus for time-reversed-doppelgängers<sup>118</sup> – people (and regions) who are equivalent to us in every way, but appear (to us) to be going backwards in time. Note that there is an objection to the time-reverse-doppelgänger thought experiment, given by Tim Maudlin (2002). I will not get into the details of such an objection; I will just briefly outline it here and say something about why it is not applicable to me.

Maudlin’s objection to the doppelgänger thought experiment is that the doppelgänger story presupposes a world without objective direction, and thus the story cannot be used to argue against objective direction without being a question-begging or circular argument. Price (2009, §3.10) replies that Maudlin has misunderstood the dialectic in which the thought experiment is used – or at least the dialectic in which Price is using it – and thus Maudlin’s objection that the argument is presupposing what it is trying to show, does not apply. In my case, a similar reply can be given. I would agree with Maudlin that I am presupposing a world without objective direction, but I am not using the doppelgänger story to establish that. Rather, I have established a lack of

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<sup>117</sup> Generally it is not thought that a B-theoretic view is necessarily committed to denying a global, fundamental direction to time. But I do hold that the B-theory is incompatible with such a position due to conclusions reached in Chapters Two and Four. In Chapter Two, I define the B-theory as a view that denies an objective moving present. Then in Chapter Four I show that without an objective moving present the only thing that might possibly give time an objective fundamental direction is asymmetries in or of time. But I then argue in §4.2, by appeal to Price (2009), that even those asymmetries are not sufficient.

<sup>118</sup> Note that time-reverse-doppelgängers are distinct from backwards-brains. I will expand on the differences at the beginning of §5.4.



objective direction previously, in Chapters Two and Four. Hence Maudlin's objection to the doppelgänger thought experiment is not applicable in my case. This is because I am using the doppelgänger story to make some points about local time direction and the role that consciousness can play in fixing a non-objective, non-fundamental direction of time. So, I am not using the doppelgänger story to presuppose what I am trying to show.

### 5.3. Accounting for the Experience of Passage

In this section I will present a brief account of the *experience* of passage on a B-theoretic view, on which there is no *objective* passage out there in the real world. I shall employ a form of (what is known as an) epistemic argument.<sup>119</sup> Epistemic arguments, as the term is used in the philosophy of time, are arguments based on an appeal to knowledge or experience. The argument that I will give is a type of epistemic argument because I will be appealing to the differences (or lack thereof) in *experiences* between a world with passage and a world without. I will explain how it is possible that a B-theoretic world without objective passage can be experientially equivalent to an A-theoretic world with passage. This in turn highlights that the B-theorist can have a world with the *experience* of passage and direction, without postulating the existence any objective passage or direction.<sup>120</sup>

I endorse the view that causation fixes the asymmetry of time, the differences between the two directions, and the structure of items and events in space-time. But I also endorse a view like that of Price (1992, 2009; Price and Weslake 2009) that it is consciousness that fixes a *direction* to those causal (and hence temporal) chains. Direction is not some feature of the external world, but a convention, determined by conscious experience, i.e., by our position and perspective as agents in time.

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<sup>119</sup> See Callender (2012) who discusses epistemic arguments.

<sup>120</sup> Remember, the B-theorists reject the notion of objective passage of the present and instead take an indexical view (see Chapter Two), and reject the objective direction (see Chapter Four).

Note that I do not intend to use this epistemic argument to be an argument against the passage and direction of time;<sup>121</sup> that argument was already given in Chapters Two and Four. I intend it only to be an argument about how it is possible for there to be an *experience* of direction of passage. The point of the epistemic argument, as it is used here, is to encourage some conclusions about why we might *experience* passage if there is no passage out there in reality.

Let us begin the thought experiment. Suppose we have a possible world in which there are moments on a linear temporal axis and that those moments are labelled or called: A – B – C – D, in that structure (or order). Suppose next, for the sake of the argument, that this is an A-theoretic world, a moving spotlight world in fact, and so there is an objective NOW that illuminates certain moments, which means that those moments are present. In this world, the spotlight of NOW will move from A to D; call this **scenario 1**. Suppose also that in this world there are facts about what other moments I remember or have knowledge of, at each moment, and those facts are eternally true.<sup>122</sup> So here are the facts about each moment:

*Moment A* – At A I think it is the present, and that B is in the future.

*Moment B* – At B I think it is the present, and that C is in the future, and A in the past. Plus I remember what happened at A, and included in remembering A is the feeling that A is present and B is in the future.

*Moment C* – At C I think it is the present, and that D is in the future, and A and B are in the past. Plus I remember what happened at A, and included in remembering A is the feeling that A is present and B is in the future. Plus I remember what happened at B, and included in remembering B is the feeling that B is present and C is in the future.

*Moment D* – At D I think it is the present. Plus I remember what happened at A ... and at B ... and at C ...

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<sup>121</sup> This is what Price (2009) and Maudlin (2002) are doing when Maudlin claims that Price's appeal to doppelgängers is circular or question begging. See the end of my §5.2.

<sup>122</sup> I, or some other agent.

And so on with other moments.<sup>123</sup> At each moment or event in time there will be facts about what happened/happens at that moment, and those facts are true eternally.<sup>124</sup> Given that my memories are accumulating in the *A* to *D* direction I will experience the ‘passage’ of time in the *A* to *D* direction. I take this scenario to be non-controversial – assuming we are accepting a moving spotlight view of time.

**Scenario 2:** Let us suppose that we have the exact same moments of time: *A* – *B* – *C* – *D*. Suppose also that all of the facts about those moments are the same as in scenario 1. For example, those moments are in the same linear structure as they were in scenario 1, and the same experiential facts are true of each moment (i.e., at *B* we remember *A*, at *C* we remember *A* and *B*, and *D* we remember *A*, *B*, and *C*, and so on). This is because facts about moments/times/events do not change – this is true on both *A*-theoretic and *B*-theoretic models.

Now suppose that once the *NOW* reaches *D* (as per scenario 1) that the *NOW* turns and runs back the way it came, from *D* – *C* – *B* – *A*. This is a case in which we might say that time reverses. Or at least, that the direction of the passage of the *NOW* has reversed. What do I experience at each moment, and how does it differ from when time ran ‘forward’? I will explain that it does not, and cannot, differ. As we have already established, at each moment there is a fact about what happens, it is the case that at *B* I remember what happened at *A*, at *C* I remember what happened at *A* and *B*, and at *D* I remember what happened at *A* and *B* and *C*. This will also include facts such as my

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<sup>123</sup> I take it that this is also a description of what is going on when memory accumulates and a description of the facts at each moment, in the actual world.

<sup>124</sup> “Take any event – the death of Queen Anne, for example – and consider what changes can take place in its characteristics. That it is a death, that it is the death of Anne Stuart, that it has such causes, that it has such effects – every characteristic of this sort never changes. ‘Before the stars saw one another plain’, the event in question was the death of a queen.” (McTaggart 1993 [1927])

seeming to experience time as running from *A* to *D* given that I am accumulating memories in one direction (the *A* to *D* direction) and not the other. Therefore, while it might be the case that time is rewinding, in some independent and objective sense, it will still seem to me at each moment as if time is running forwards, because memories are accumulating in the *A* to *D* direction, and because of the facts about each moment. In scenario 2 my experience of time is exactly the same as in scenario 1, because the facts about what I have experienced are the same, regardless of the movement of the NOW.

Next suppose a further scenario; **scenario 3**. Suppose that instead of the NOW moving ‘backwards’ as per scenario 2, it actually jumps around all over the time line. First *A* is present, then *C*, then *B*, then *D*, then *C* again, then *A*, and so on. Even in this scenario it will still be the case that there are facts about each moment, such as: the fact that at the moment *C* I remember what happened at *A* and *B*; I feel as if *B* was the moment just before *C*; and I also remember being at *B* and thinking that *C* was still to come and that *A* had just been. Thus, even in the case of scenario 3, it will still appear to me as if time is passing in the direction from *A* to *D*. This is because at each of these moments it is a fact that it appears to me as if time is passing in the *A* to *D* direction. Scenario 3 is also *experientially* equivalent to scenario 1.

However, as we know from Chapter Two, making sense of a story like this requires us to introduce a kind of hyper-time into our story. What I mean by this is that when we imagine scenarios 1, then 2, then 3 happening, we may have imagined *A*, *B*, *C* and *D* as four snapshots from a film, each perhaps a second apart,<sup>125</sup> playing out on a screen in a dark room: *A* – *B* – *C* – *D* (as per scenario 1), then *D* – *C* – *B* – *A* (as per scenario 2), then *A* – *C* – *B* – *D* – *C* – *A* (as per scenario 3), and so on. We readers who are imagining these events are analogous to a person in a darkened room watching the snapshots from a film play out on the screen. The problem is that in order to make sense of the story we have employed a hyper-time within which the events take place.

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<sup>125</sup> Of course, time is most likely continuous and not discrete, but I use a discrete example for ease of illustration.

When time ‘reversed’ as per scenario 2, it reverses from the perspective of the hyper-time or second level of time within which it exists, i.e., from the perspective of the person watching the film. In this scenario it is as if there is a first time that A happens, and a second time, and a third time, and so on. The same goes for the other events in the time line. But in Chapter Two we have rejected the notion of the A-theory, and the possibility of employing hyper-time, because they both fall prey to McTaggart’s paradox (or some analogue of it). So let us imagine the same scenario without any objective NOW passing across the moments A, B, C and D, nor any hyper-time within which that NOW exists. This is **scenario 4**.

In scenario 4, we have the same moments A, B, C and D, and we have the same facts about each of those moments (that at C I remember A and B, and so on). What we do not have is the objective present or NOW and the hyper-time within which it exists. There is no direction in which these events ‘really’ happen, but there is structure (or non-directed order). The events simply exist all laid out on an axis, without anything passing, and without any privileged direction. Now imagine again the screen playing out the shots A, B, C and D, from the film, and the observer watching in the dark room as hyper-time runs by. But, for scenario 4 we remove the world outside of the screen. Not just the observer, but the whole world. Not just physical stuff, but (hyper) space and time. In scenario 4 there is *nothing* outside of the moments A, B, C and D. We are left with simply the moments A, B, C and D, and the facts about what *happens* at each of those moments, and facts about what I, the agent, *experiences* at each of those moments. So, what would I experience as an agent in scenario 4? I hold I would experience time just the same as in scenario 1. Even if there is no hyper-time at which those moments ‘happen’, there will still be facts about what I experience at each of those moments. It can still be built into the facts about each of those moments that my memory accumulates in one direction and not the other, that I *feel* as if time is passing due to the way I remember each moment before, and remember remembering moments before, and so on.

The conclusion to draw from this is that we do not need a present, a NOW, to exist and to be moving along or passing over the times or events at times, in order for it to *appear*

to us as if there is passage. The thought experiment takes us through a number of scenarios which I hope lead us to the conclusion that, at each scenario, what we would experience (with regards to passage) is the same as in the scenario before. Then we reach the final scenario in the thought experiment in which there is no passage at all. What I mean by saying that the experience is the same at each scenario is that the experience of the supposed passing of time in scenario 1 is the same as the experiences in scenarios 2, 3 and 4. I do not mean that the experience at moment *A* is the same as the experience at moment *B*. It is not the case that the only way to account for the *experience* of passage or flow is to postulate an objective moving NOW, as the A-theorists do. Instead, the B-theorists can hold that so long as there are facts about what is experienced at each moment, that those experiences include memories, and that those memories accumulate in one direction, then there will be the right kind of facts about mental states for the B-theorists to account for the *experience* of a flow or passage of time.

It should be noted that I do not at all intend to claim that this is a full defence or account of the B-theorists' experience of passage. Doing so is a large task which is beyond the scope of this thesis. This section is simply a short story to provide some support to several of the intuitions that might guide a B-theorist to hold that the world does not contain any objective passage, while still accounting for why we experience the world as we do with some flow-like qualities to our temporal experience.

#### **5.4. Dummett, Backwards Causation, and Backward-brains**

In this section I will appeal to cases of 'Backward-brains' as another thought experiment that provides support for the role of consciousness in our labelling one of the two directions of time as 'the' direction. In the previous sections (§5.1 and §5.2) I have considered cases where the direction of time and causation – since they are one and the same – go in the direction opposite to that of time in some other region of space-time. I will call these cases 'time-reversed' cases, and in a moment I will make a distinction and contrast them with 'backwards' cases. I have shown why we cannot call these cases 'backwards' or 'reversed' in any objective sense since both time and causation are going

in the same direction as each other,<sup>126</sup> and thus backwards time-travel does not involve backwards causation. In the previous ‘time-reversed’ cases, the reversal was only relative to some other region, but it was a full reversal within the example, or within the region of space-time. In the time-reversed cases, there was no objective fact about which of the two regions – the regions which had their events ordered oppositely to each other – was the region with correct, or normal, ordering.

Nevertheless, I now want to consider a different type of case; one in which it might more easily be said that something – time, causation, memory – is going ‘backwards’, given that the reversal is only partial. It is important to note that this case is *not* analogous to the case from both §5.1 and §5.2, and so I should also make a distinction between time-reversed doppelgängers (or doppelgängers for short), and backward-brains; and then following that distinction, between ‘time-reversed’ cases, and ‘backwards’ cases.<sup>127</sup> This is not a distinction that others make – for example, Price (2009, §3.10) calls the section in which he talks about (what I call) time-reversed doppelgängers “Maudlin vs. Boltzmann on Backward-brains”. But I see the time-reversed-doppelgänger examples given by Boltzmann (1964), Maudlin (2002), Price (2009), and Williams (1951) to be different in an important way from the example given by Dummett. Thus I will call one a ‘backward-brains’ case and the other a ‘time-reversed doppelgänger’ case, and make a distinction between them.

The time-reversed-doppelgänger is someone who is equivalent to us in every way, except that they are in a region in which time and causation appears *to us* to be going

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<sup>126</sup> Notice that while I talk about time and causation ‘going’ in some direction, there is no privileged direction to time or causation. I will explain in §5.5 – §5.7 how the causal asymmetry is given by the direction in which we accumulate memories, and that this is not an intrinsic asymmetry.

<sup>127</sup> Using the terms reversed and backwards seems to suggest that there is a right and wrong way that time and causation could go. It can be useful to talk this way, matching the ‘right’ way with the way we experience time and causation as going in, but I will explain in §5.6 that time and causation do not truly ‘go’ in any direction at all.

backwards. However, to the doppelgänger, it is *we* who appear to be going backwards. The previous cases (§5.1 and §5.2) were of time-reversed doppelgängers and time-reversed regions. In the previous cases, there was a complete reversal: the reversed doppelgängers and the reversed regions are equivalences to their supposed forward directed doppelgängers and forward directed regions. I explained that since there is no objective fixing of some direction of time, or arrow independent of the direction that causation goes, then this is equivalent to no reversal at all. The time-travel case should be taken to be a type of time-reverse case, and the time-traveller as a type of time-reversed-doppelgänger case.

However, the story that I want to present here, in §5.4, is one in which there is only a *partial* reversal, and hence one which I will call a ‘backward-brains’ case. In the backward-brains case, some events are reversed (the external events) and some are not (the mental events). In this sense it is unlike the time-travel case, and the fully reversed time-reverse-doppelgänger. In the backwards brain story: either the events of external causation (represented by letters A, B, C, D, E, as per figure 14) happen in a direction *opposite* to that of the events of internal causation, like perception and memory (represented by letters V, W, X, Y, Z); or, the events in the external world happen in the ‘normal’ direction, and it is the mental events that happen in the opposite direction – hence *backward-brains*. So the backward-brains cases should be distinguished from the time-reverse-doppelgängers cases. The two cases are distinct. This is because in the backwards brain case the reversal is *partial*, whereas it is full or complete in the case of the doppelgängers. The time-reversed-doppelgänger and the time-traveller do not perceive any events going backwards, because the reversal is full, not partial.

Note that the *brains* or minds – the oppositely directed perceivers – are central to the backward-brains case. This is because if there were not *conscious agents* in a backwards-brain world the scenario would be equivalent to a mere time-reverse world.<sup>128</sup> Without

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<sup>128</sup> To be precise, the worlds would perhaps *not* be equivalent, because there would need to be some difference in the laws of nature, or the physical make-up of (possible, if not actualised)



some observer or agent whose brain or mind is ‘going’ the opposite way (or the ‘wrong’ way) in comparison to the external world, then the Dummettian backwards case (or partial reversal case) would be a case of full reversal instead, and therefore analogous to a time-reversed case, i.e., a local time scenario, and perhaps also a time-travel scenario. So, not just any old partial reversal would do; the reversal that is required to make some case a backward-brain case especially requires the brain or consciousness of at least one observer or agent.

Let me here make a note about brains and minds. To an extent, I am using the notions of ‘backward-brains’ and ‘backwards minds’ interchangeably. ‘Backward-brains’ is not a term coined by me; rather, I am following the term used by other philosophers. ‘Backward-brains’ is the name given to the people whose minds accumulate memories in the opposite direction. I will talk about the story or thought experiment as a ‘backward-brains’ type story, and backwards *mental events* and backwards *memory accumulation* is what happens to the people with backward-brains, or minds, in the backwards brain story. In the backward-brains story, the things that are really backwards are the mental events. What these mental events are is the order in which they (the backward-brains) are perceiving the non-mental, external events. It is not necessarily that the physical brains themselves are ‘backwards’, rather it is their perception of external events. Although, presumably, there will need to be some different physical construction of the brain, or different laws of nature (different when compared to the actual world), in order that non-mental, external events can remain the same (as the actual world) yet the brain accumulate memories in the opposite order. Note also that using ‘backward-brains’ and ‘backwards minds’ like this might imply that I am using some kind of identity theory or supervenience account of minds and brains. While this is true, I take it that one could just as easily give some dualist account of mind and simply change all the ‘brains’ into ‘minds’, and then the same story can be told. So the account of mind that one holds is not crucial to the thought experiment.

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humans or other conscious creatures, in order for us to say that two different groups of people are accumulating memories of the same events, yet in a different (oppositely directed) order.

The backwards brains story which I will use is based on an example given by Dummett in *Bringing About The Past* (1964). I will argue that causation is not asymmetrical in the ways in which Dummett claims it is in his backwards brains type story. Dummett is trying to show that mental events or consciousness could not go in the opposite direction. If he is right, then it undermines my claim about the role that consciousness plays in fixing one of the two directions as *the* direction of time. This is because on Dummett's view (as we will see from his backwards brain case) there is some metaphysical fact that makes one way of memory accumulation, prediction, remembering, and anticipation the correct way, and the other way the wrong way. On his view, it is the asymmetries in the world that make it the case that mental events happen in one direction and not the other. However I want to preserve the possibility that while causation gives us asymmetries in space-time, the direction of time is a feature of our consciousness – specifically, of the way in which our memories accumulate over time. I will explain why I think Dummett is wrong to claim that causation is, in two particular ways, asymmetric (he thinks there is a *prediction* asymmetry, and an *indeterminism* asymmetry). Instead I will show that, while there may be *other* asymmetries of causation, contra Dummett, causation is symmetric in these two respects, and thus it is possible to have cases of backwards brains – people who remember and anticipate events in an opposite direction from us. And, therefore, that while causation can be asymmetrical, it is asymmetrical in such a way that it allows the direction of time, or more specifically, the *experience* of there being a direction of time, to be grounded in facts about consciousness.

I will call the backwards brains case that I will be discussing, a 'Dummettian world', because I am basing my discussion on Dummett's example. I will also talk as if the backwards brain story happens, not in a region of the actual world, but in another possible world.<sup>129</sup>

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<sup>129</sup> Tooley (2013 manuscript), in a golf example, has his backwards brains people exist in a *region* of the *same* possible world.

As an aside, it might be possible for the scenario<sup>130</sup> in the backwards brain world and the scenario in the actual world to cohabit in the same world, i.e., to be *one* world with a region akin to the actual world, and a region akin to the backwards brains world. For example, the Gold Universe may be one in which this type of Dummettian semi-reversal happens in a *region* of space-time (rather than in another possible world). However, there would need to some kind of explanation, such as an appeal to laws of nature, about why the actual world (and its time-travel region) ordered the external events as A, B, C, D, E and the internal, mental events as V, W, X, Y, Z, whilst the Dummettian world ordered them A, B, C, D, E and Z, Y, X, W, V (see figure 14). Given this, it seems to be less complex to simply postulate that the Dummettian style example or scenario is in a possible world of its own, and that some differences in the laws of nature would account for the differences in event distribution between our world and the backwards brains world.

It may be thought that I would not want to argue against some account of causal *asymmetry*, such as Dummett's, since causal *symmetry* would be problematic for my view given that I have argued in defence of a causal theory of the direction of time in §4.4. This is because a causal theory of the direction of time appeals to the *asymmetry* of causation to account for the direction/asymmetry of time. But the reason it is not problematic that I argue against Dummett's causal asymmetry is because I am only arguing against it to the extent that it postulates *certain* content asymmetries. I argue against his view that memory and prediction (of the future) can only happen in one direction and not the other, and that there is causal determinism in one direction and not the other. I will disagree with Dummett on the memory, the prediction and the causal determinism claims.

In his paper "Bringing about the Past", Dummett appears to hold a causal theory of the direction of time, or at least holds that causation is *bound up with* the direction of time, even if causation is not the feature that *grounds* the direction of time. He states:

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<sup>130</sup> By *scenario*, I specifically mean the distribution of events in space-time.

*“the causal relation has a temporal direction: it is associated with the direction earlier-to-later rather than with the reverse ... this association of causality with a particular temporal direction is not merely a matter of the way we speak of causes, but has a genuine basis in the way things happen.”* (Dummett 1964, 338).

He uses his examination of a backwards world to provide support for his position that causation is temporally asymmetric, especially with regards to a few specific features. My main aim for this section is to consider whether causation is temporally asymmetric in the way that he claims, i.e., with regards to those features. Dummett argues that causation is asymmetric since (among other things<sup>131</sup>) a backwards brains case is a logical impossibility. In this section I will show why the features that he appeals to as causally asymmetric – namely our ability to predict the future but not the past, and his claim that there are random or causally indeterministic events in one direction but not the other – are not in fact asymmetric.

Consider this extract from Dummett which sets up the scenario:

*“... imagine ourselves observing events in a world just like the actual one, except that the order of events is reversed ... we should have great difficulty in arriving at causal explanations that accounted for events in terms of the processes which had led up to them. The sapling grows gradually smaller, finally reducing itself to an apple pip; then an apple is gradually constituted around the pip from ingredients found in the soil; at a certain moment the apple rolls along the ground, gradually gaining momentum, bounces a few times, and then suddenly takes off vertically and attaches itself with a snap to the bough of an apple tree. Viewed from the standpoint of gross observation, this process contains many totally unpredictable elements...”* (Dummett 1964, 339).

What do we mean when we say that Dummett’s apple story is a ‘backwards’ story, given that I just argued (in §5.1 and §5.2) that time and causation cannot come apart and therefore neither time nor causation can go ‘backwards’? What we mean is that the way in which we perceive external events, A, B, C, D, E, compared with the way in which our memories accumulate in this backwards world, is opposite to that in our ‘normal’ world. In our normal world we think that the arrows of external causation and internal,

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<sup>131</sup> Such as his examples of backwards causation.

mental causation match-up or ‘go’ in the same direction. Whereas in this Dummettian backwards world, those two arrows do not match-up, they ‘go’ in opposite directions (see figure 14). Regardless of direction, the ordering between the actual world and its time-travel region is different from the ordering of the Dummettian ‘backwards brains’ story. In the actual world and in the local time-travel region (the backwards case) the following event pairings are simultaneous: A&V, B&W, C&X, D&Y, E&Z. But in the backwards brains case, the simultaneous pairings are different: A&Z, B&Y, C&X, D&W, E&V.

In this Dummettian world, a rather rotten apple sits on the ground near an apple tree, over time it becomes less withered, becoming perfectly ripe, then one day it starts rolling along the ground, begins to bounce and suddenly jumps up attaching itself to the apple tree, where over time it becomes under ripe and gets smaller and smaller till it eventually turns into a little apple blossom. The external events that we would perceive if we were agents in that world would be running opposite to the direction that we perceive them in our actual world. Our internal mental events would run as normal, V, W, X, Y, Z, but external events would appear to run in the opposite direction: E, D, C, B, A.

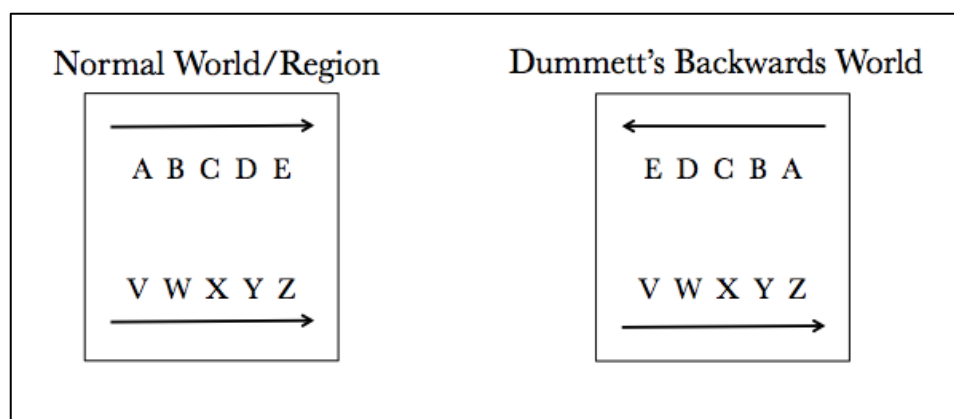


Figure 14: Directions in our world and in Dummett's Backwards World

Dummett claims that this backwards world would contain “many totally unpredictable elements”, and that the “facts would cry out for explanation, and we should be unable to provide it” (1964, 340). He presents this example as evidence of the asymmetry of causation. This is because he intends the example to show the backwards (partially

reversed) world to be absurd, and thus to illustrate the asymmetry of causation. I think that Dummett is mistaken, and I will show why, hence rescuing the logical possibility of backwards brains cases. Then in §5.7 I will explain how causation can still be said to be asymmetric, and can ground the difference between the two directions in time, despite rejecting the asymmetries that Dummett presents.

Why do I disagree with Dummett? **Firstly**, I disagree that successful prediction would be difficult or infrequent in this backwards world. In the Dummettian backwards case, given that we (as readers) know the world is running backwards, we have no trouble predicting that a withered apple lying on the ground will become un-rotten and eventually ripe. We have no trouble predicting that when the apple starts rolling and then bouncing along the ground that it is going to jump up into the air, probably attaching itself to the apple tree. And we have no trouble predicting that the small green apple will get smaller and smaller until it eventually turns into a little apple blossom.

Let us consider a second story of the Dummettian, backwards sort. Imagine there is a boy standing in a swimming pool. At first the water is calm but then it begins to ripple with the ripples moving inwards towards the boy. Next some splashes of water come from around the swimming pool and land near him and the boy starts to rise out of the water. We can imagine or predict what will happen next, given that we have probably worked out that the story is one of a boy jumping into a pool, but in reverse.

Let us consider a third case of Dummett's backwards sort. Suppose a person looks over a pile of broken glass on the floor with a shocked face. The shards of glass start to move and join together forming into the shape of a cup. It would then be no surprise to us if the glass cup started to rise up towards the edge of the table and an elbow came to meet it. The conclusion to draw here is that we can in fact predict events when the order of events runs in the opposite direction from our own, and yet we are not even inhabitants of that world who experience this reversal every day.

The conclusion that these considerations serves to show, is that causation is also predictable in what we consider the reverse or backwards direction, to an extent somewhat comparable with our forward directed world. Thus I hold that Dummett is mistaken to conclude that causation is asymmetric with regards to predictability, and mistaken to conclude that the backwards brain case is logically impossible due to this.

**Secondly**, I disagree with Dummett's claim that the unpredictability of some events in the backwards world shows the asymmetry of causal indeterminism in one direction and not the other, and therefore rules out the coherence of the backwards brains story. I will highlight that even in the actual world there is some indeterminism in both directions, and thus Dummett's appeal to the supposed unpredictability or indeterminism of events in one direction is mistaken, and does not rule out the logical possibility of backwards brains cases.

Dummett claims that in the backwards case we could not, in practice, predict the moment at which the apple started rolling unless we were to observe "the movements of the molecules in the soil" (1964, 339). However, I object that this is also true of our actual world where the events are running what we call 'forwards' direction. Consider the story of the apple, but with the events running in the direction that we would consider normal or forwards. And consider the moment at which the apple falls from the tree. Likewise in the 'forwards' direction, without the aid of lots of technology, measuring instruments and calculations, we could not predict the moment at which the apple will fall, how many times it will bounce, or how far it will roll.

Likewise for the boy in the swimming pool and the glass cup, in the normal or forward directed cases. Without such aid (knowing the movements of the molecules, etc) we could not predict the exact moment the boy will jump, how high the splash will be, how long the ripples will last, and so on. Without such aid we could not predict whether the cup would break, shatter or bounce. The fact that we could not predict the exact moment that the apple would jump up and reattach to the tree in the backwards world, is not of special significance because the same can be said of certain events in the forward or normal direction of our actual world.

Whether the external events are running in what we consider the normal direction or in the opposite, time-reversed direction from normal, it is the case that many events are predictable, and some events are unpredictable. It is not the case that predictability happens in one direction and unpredictability in the other. This serves to show that Dummett is mistaken to think that the backwards brain case is a logical impossibility, or that the world is predictable in one direction only. Regardless of which view of causation one holds, there are regularities to the causal relation, and such regularities give rise to some level of predictability, and sometimes unpredictability, in *both* temporal directions.

### **5.5. Is there ‘Memory’ or ‘Prediction’ in the Backwards world?**

As well as the unpredictability claim, Dummett also makes a claim about memory. He claims that if events were backwards (i.e., if *we* were the backwards-brains) then we would not have *memory*, we would have *precognition* because we accumulate memories of the events in the opposite direction. I think that this claim is also mistaken.

Before we go any further, I should point out that a scenario in which we (or the agents in this world) accumulate memories in the reverse direction yet external causation runs normally (as per figure 14), *and* a scenario in which we accumulate memories in the normal direction yet external causation runs in the reverse direction, are equivalent (as per figure 15). In either of those two scenarios the direction of mental causation and the direction of external causation do not match up the way they do in our actual world. But there is no fact of the matter as to whether it is the mental or external causation that is running backwards. This is because we have postulated that there is no overarching arrow which says which of the two arrows – the arrow of external events, or the arrow of internal mental events – is going in the normal direction, and which in the reverse direction.<sup>132</sup> Note that without this overarching arrow, it is possible that time and causation are local. I will return to local time in §5.8.

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<sup>132</sup> See Chapters Two and Four.



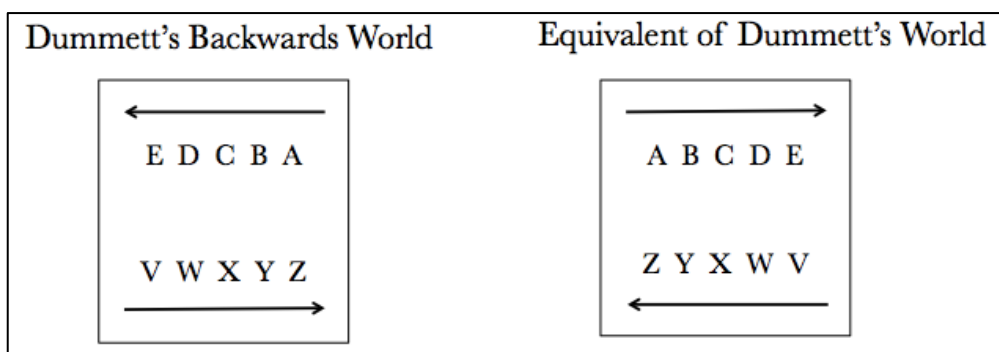


Figure 15: Directions in Dummett's Backwards World and its equivalent.

What reasons do we have for thinking that the people in this time-backwards world are *precognising* rather than *remembering*? I hold that there is none. This is because, without some overarching arrow, without there being an *objective* fact about which direction is the past direction (as ruled out in Chapter Four), then it is not clear what criteria we have for calling this knowledge 'precognition' rather than 'memory'.

Given this, I propose that the answer is simply to say that if those people have memory-like knowledge of some direction, and expectation or anticipation of the other direction, then we should call the direction that they have knowledge of 'the past' and we should call that knowledge 'memory'.

Let us consider an example. Suppose there is a series or chain of events, A, B, C, D, E, F (the letters can be substituted for events in the journey of the apple), and these events happen in a world with no privileged direction of time. If some agent in this world has knowledge of all the events that are (represented as being) on the left of some event in the chain, then we would want to say that these events would be in the agent's 'past', so he would be 'remembering' them.

Likewise, suppose we have a chain of events A, B, C, D, E, F, and suppose that at D I know what happened at A, B and C. Suppose at E I know what happened at A, B, C and D. And suppose at F I know what happened at A, B, C, D and E, as well as knowing what it was like to be at C and to know what happened at A and B but not at D, E, or F. That sounds a lot like memory of the past, to me. At any point in time I (or

the agents in this world) have knowledge of, or *remember*, what happened ‘before’, as well as what it was like to be at that point in the past and only remember events before it.

To illustrate, consider the case of the apple again, and suppose that you are an inhabitant of the world in which the apple story happens. We have already said this is a backwards brain world (the direction of external events and the direction of mental events are not running in the same direction). In this world, it appears as if the apple is first rotten, then it becomes ripe, then bounces and reattaches to the tree where it becomes under-ripe, gets smaller and smaller, and then turns into an apple blossom. Consider the moment at which it attaches to the tree. As a backwards brain inhabitant of that world and an observer of the apple’s journey, we are inclined to say that you will have memories of the apple being rotten and on the ground, and then of the apple being ripe, then bouncing along the ground. We will also be inclined to say that you do not yet have memories of the apple becoming green, or turning into an apple blossom, because, at the moment at which the apple attaches to the tree, those events have not yet happened (although you can *predict* that this is what will happen).

Someone might want to say that in this story we are ‘remembering’ the future, but if they claim this, it seems that they are building the direction into the claim. If it is a requirement for ‘memory’ that it accumulates in a certain direction then we could say that they have precognition rather than memory. But I do not think this is what we want an account of memory to be. I also object to this understanding because in employing it we are using the direction to account for psychological features like memory, rather than using the psychological features to account for the apparent direction – as per my endorsement of a perspectivalist account like Price’s.

If, instead, what it means to ‘remember’ something is that we have a certain kind of knowledge, such as experiential knowledge, and that it accumulates in a certain kind of way, then I think we can call that knowledge ‘memory’. This is a more promising understanding of memory because it appeals to the features of memory itself, rather than appealing to temporal direction.

Given this, what we can do is define the past as those moments that are in the direction in which we have memory, and the future is defined as the direction towards which those memories accumulate. For example: we have an experience of (the events at) time *A*, and we have an experience of time *B* while having memories of *A*, and we have an experience of time *C* while having a memory of *A* and *B*, and so on. We can then define *A* as being in the past direction, or the earlier direction, and the *A* – *B* – *C* direction as the way in which time and causation (apparently) ‘goes’ (as opposed to the *C* – *B* – *A* direction). By ‘apparently’, I just mean that there is no direction in which time and causation objectively ‘go’, or pass. Instead, the experience of direction and passage is a feature of the way our memories accumulate, as set out in §5.3. A consequence of this is that in a world with no conscious agents there will be no assignment of past and future to the directions in time. I think this consequence is acceptable, and a correct description of, not just the time-travel world, but perhaps also the actual world.

### ***5.6. Causation does not ‘run’ or ‘go’ in any direction***

In earlier pictures I have depicted the external events *A*, *B*, *C*, *D*, *E*, and the internal mental events *V*, *W*, *X*, *Y*, *Z*, as having an arrow attached to them. The arrow is to help the reader identify that the events have a direction attached to them – specifically, the direction in which we normally think of them as going, the phenomenological aspect of time. I have also explained Dummett’s backwards-brain story as one in which the direction of external causation and the direction of internal, mental causation are running opposite to each other. However, this is a pure illustrative tool. I do not endorse the view that there is any ‘way’ in which causation (time, entropy, etc) objectively goes. On my account it is merely a fact that there are certain orderings or structure (see §4.1) of events at times, and that we overlay an arrow onto that order in virtue of our perspective in time; the arrow is a psychological feature. Thus we should note that while the events *A*, *B*, *C*, *D*, *E*, and *V*, *W*, *X*, *Y*, *Z*, do exist in the structure that they were in earlier diagrams from this chapter, if we are being precise, the correct way

to illustrate the scenarios would be with double ended arrows (as per figure 15) so as not to privilege one direction over the other.<sup>133</sup>

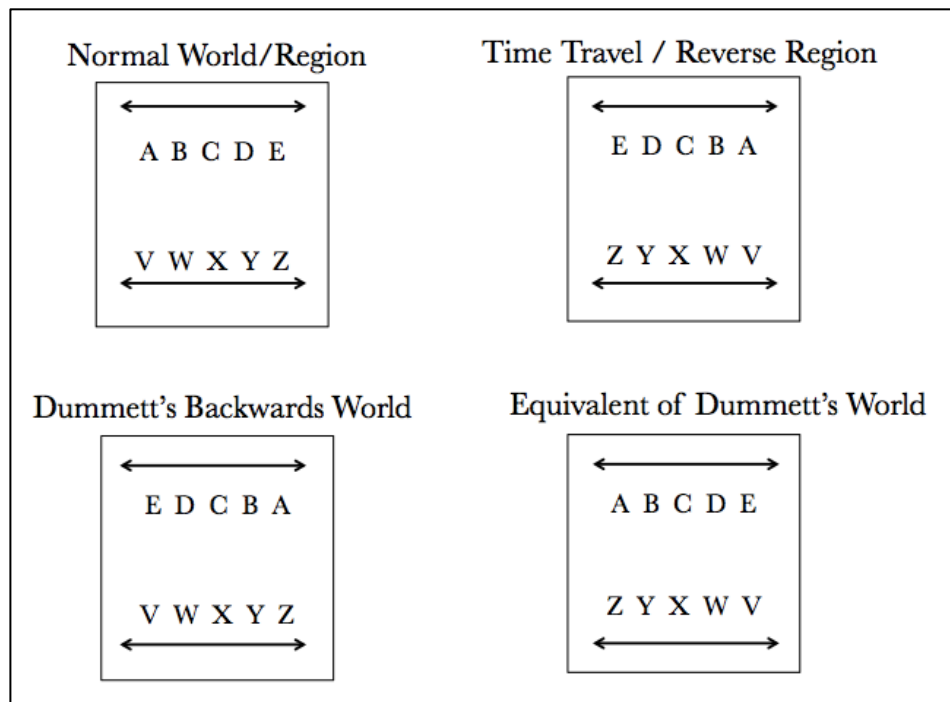


Figure 16: Chapter Five's scenarios represented without privileged direction.

Without some kind of direction of time (represented by the agent watching the screen, for example) which exists independently and externally from the events A, B, C, D, E we are not able to say that there is some direction or order in which the events happen, nor that there is a fact of the matter whether they happen backwards or forwards. This conclusion was mostly established in Chapter Four, as well as supported by a claim I made in §5.1 (which appeals to ideas defended in Chapter Four) where I deduce that there is no *backwards* causation or time; there is just *opposite* causation and time. The fact that there is only oppositely directed causation follows from the fact that there is no objective single privileged direction. I will not say any more about this because it has been sufficiently discussed in Chapter Four and in §5.1.

### 5.7. Causation, Memory and Direction

<sup>133</sup> Remembering from Chapter Four that every linear dimension has two directions, in the normal, non-privileged understanding of 'direction'.

In the previous chapter I endorsed the view that *temporal ordering* reduces to *causal ordering*; I endorsed a type of causal theory. But in *this* chapter, I have implied a view in which certain mental or psychological features – particularly memory accumulation – is what gives causation and time a *direction*. It is important to note the two appeals (to causation and to memory) are not conflicting accounts of temporal direction. I am not using both memory accumulation and causation to account for a direction of time. Instead, there are two distinct explanatory or reductive endeavours here. **Firstly**, there is the appeal to causation in order to account for certain features of time, in particular, temporal asymmetries. This is Endeavour One (E1), which was the focus of Chapter Four. On this account, facts about time – specifically asymmetries – are grounded in facts about causation. But note that a fact about *direction* is *not* included in the story which grounds time in causation, because I hold that there is no objective fact about temporal and causal *direction*. This is because in Chapter Four I argued that although there may be a reduction of time to causation (or some other asymmetry like entropy) there is nothing in the reduction that is enough to provide a privileged direction; a direction in any strong sense.

**Secondly**, there is the appeal to memory and other mental events, both in order to account for an *experience* of passage, and for an assignment of direction (singular, privileged) to time and causation – but not to account for any *objective* passage nor direction, as I deny such a thing. This is because the reduction of time to causation cannot give us a direction in any strong sense of the notion of direction. This understanding of passage and direction is a type of anti-realist, perhaps idealist, notion as it supervenes upon mental events. Any talk about *direction* is not about some features of time and causation in themselves, but about our perspective and orientation in time – specifically the way our memories accumulate. This is Endeavour Two (E2). In this section (§5.7), I want to briefly cover what it means to hold a psychological account of how we assign a *direction* to time and causation.

In the previous section (§5.6) I explained that there is no privileged way in which causation ‘runs’ or ‘goes’, and by this I mean that there is no independent, objective

direction to causation. Causation does not pass or flow any more than time does. And the relationship ‘causally connected’ is a symmetric relation: if A is causally related to B, then B is causally related to A.<sup>134</sup> But while I deny there is causal (and hence temporal) *direction*, I do not mean to deny any causal (and hence temporal) *asymmetry*. In fact, this is the extent to which I want to endorse a causal theory of time. I hold that temporal asymmetries are grounded in, or reduce to, causal asymmetries (depending on which types of asymmetry one is talking about) this is (E1).

It should be noted again that differences between the two directions in time do not give a *direction* of causation. At most they give us ways to orient ourselves in time in virtue of these causal asymmetries. There may be a number of causal asymmetries or differences between the two directions in time and causation, but that does not give us a way to pick one of them as *objectively* privileged (as I also argued in the case of a direction of time, in Chapter Four). But since there are differences between the two directions, we can use the differences to choose one of those directions as the ‘later to earlier’ and the other the ‘earlier to later’, and then say that ‘the’ direction of time goes from the stipulated earlier to the stipulated later, and not from later to earlier. But this is an account of the direction of causation based on convention, and not on an objective independent notion of a direction of causation.

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<sup>134</sup> Dainton makes this point nicely: “A cause *c* produces an effect *e*, if we say that in the given circumstances, *c* is both necessary and sufficient for *e*, then since the relationship “necessary and sufficient” is symmetrical, we are clearly committed to holding that *e* is necessary and sufficient for *c*. For example, suppose a spark ignites a fire, in the circumstances [...] the fire would not have occurred if the spark had been absent, so *the spark was necessary for the fire*. It is also true that, in the circumstances *the spark was sufficient for the fire* (nothing else was needed). Now look at the situation the other way. In these circumstances, for the fire to ignite the spark had to occur, so the fact that the fire did ignite guarantees that the spark occurred: *the fire is sufficient for the spark*. Also, since the occurrence of the spark guarantees the fire will ignite, the spark couldn’t occur without the fire, so *the fire is necessary for the spark*. The two events, the cause and effect, are thus related to one another in a perfectly symmetrical way.” (2010, 52-53).

Rather than discussing all the particular causal asymmetries, I want to focus on just one: the asymmetry that I take to be the key asymmetry in accounting for our experience of direction and passage of time. By that I mean, focusing on the asymmetry that accounts for our perception of a passage and direction of time (E2). Following Price (and, Price and Weslake), I hold a mental or psychological account of the asymmetry and direction of causation.

*“[T]he second option we noted is to agree with Hume that there is no intrinsic asymmetry of causation, but to look for some better story than Hume’s about why our causal notions show such a strong and temporally-asymmetric asymmetry ... one obvious candidate for the beginnings of such a story [is] our own perspective as agents and deliberators.”* (Price and Weslake 2009, 37).

While my focus is on *memory* and how it accumulates, and I use this to account for the (apparent) direction and asymmetry to causation, Price and Weslake appeal instead to *deliberation* as the crucial feature. However, we agree on the role that our *perspective* or asymmetric viewpoint plays in assigning direction to causation. Price and Weslake claim, “[i]n some cases an asymmetry is a product of an asymmetric viewpoint on a symmetric state of affairs [i.e., left and right] ... As we shall explain ... it is our perspective as deliberators that underpins the distinction between cause and effect” (2009, 9).

Ghhchc

I hold that the (apparent) direction of time is grounded in the (apparent) direction of causation, i.e., that facts about time reduce to facts about causation (E1). And I also hold that the direction of causation is not an objective, independent fact; instead it is grounded in our psychological perspective (E2). By psychological perspective I mean psychological, mental facts<sup>135</sup> about how our brains accumulate memories and the direction in which they do so. What this means is that the (apparent) direction of

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<sup>135</sup> These facts could also be *physical* facts, depending on what kind of account of the mind one holds. We could still have physical events causing the backwards memories, but we would probably need an account which includes something like *multiple realisability* of the notion of memories. We probably would need multiple realisability in order for the backwards brains people to exist in the same world (or a world with the same external, non-mental events) as the non-backward-brained people, yet have their memories accumulate in the opposite direction.

causation is given by facts about which direction we accumulate memories in.<sup>136</sup> Since the direction of causation is grounded in these psychological features, it follows that there is nothing intrinsic about A which makes it the earlier of the A-B pair. There is only the fact that we perceive A, and when we perceive B we have experiential knowledge of A, but when we have experiential knowledge of A, we do not have it of B. And the fact that we experience event A, and when we experience B we also remember A, and when we experience C we remember B and A.

It would seem that our motivation for postulating a direction of time stems from phenomenological or experiential reasons. I take it to be uncontested that there is a psychological aspect to the direction of time; that we experience (or *think* we experience) a direction of time, and that such experience is pervasive. But I have also argued in Chapter Four (specifically §4.2) that there is no objective, privileged direction of time, and that at most there are asymmetries of (or in) time. However, even those asymmetries do not give us a way to pick one of the two directions as objectively privileged. Furthermore, the backwards brain case illustrates that it is logically conceivable for us to be oriented differently than we are in time and, as a consequence, for our assignment of direction to be, for the most part, independent of the asymmetries in the world. The fact that it is logically coherent to postulate backwards brains – people whose memories accumulate in the opposite direction – highlights the fact that the direction of causation and consequently time is very much dependant on our perception (from §5.3 and §5.5).

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<sup>136</sup> It might be said that by appealing to the ‘direction’ of memory accumulation I am being circular. But I should remind the reader that I am happy to accept that there is no fact of the matter about whether we are accumulating memories or losing memories – the only difference between these two scenarios is the order in which we tell the story. However, there is a fact that at each moment I feel as if that moment is present and have memories of moments ‘before’ that moment, as set out in §5.3 (and §5.5) and this gives rise to the feeling of memories accumulating rather than being lost, and therefore of time ‘going’ in the direction in which the memories accumulate.



In Chapter Four I endorsed a causal theory (E1), but the causal theory was not enough to give us a *direction*. The causal account does not give us any direction in a strong sense. So for *temporal* direction, since we are taking a causal theory of the direction of time (E1), the asymmetric, temporal ‘earlier-than’ and ‘later-than’ relations will follow from the asymmetric ‘causing’ and ‘caused by’ relations. Causation is intrinsically symmetric; there is no reason to think that of some causally connected pair of events, one is somehow intrinsically the cause, the other the effect. But while the relation ‘causally connected’ is symmetric, the relations ‘causes’ and ‘is caused by’ are asymmetric. If A causes B, then B does not cause A, and if B is caused by A then A is not caused by B. However, it is most important to note that *which* of the two event types – A or B – is the cause, will depend on our psychological perspective or position in time. And which if the two orderings A-B or B-A is the privileged direction depends purely on a convention or assignment. This is the relevance of the backwards brains story. The causal relation between the events is an objective fact, but there is no objective fact about which of the two events is the earlier one – over and above the fact that we *perceive* one of the two as earlier. Nor is there an objective fact about which is the ‘correct’ or privileged *direction* of the two directions in time, over and above the direction that we perceive time as ‘going’ in.<sup>137</sup> The backwards brains case illustrates the relevance of our mental or psychological positioning in time to the assignment of a direction of time and causation. Where I will claim that the A type events cause the B type events, the backwards brain people will claim that the B type events are causing the A type events. Consequently, which event they think is the earlier and which is the later will be the time-reverse of that which we think is the earlier and which is the later.

Once we have assigned a direction to causation through appeal to memory accumulation (E2), we can use that assignment to give a direction to time, since temporal facts reduce to causal facts (E1). Now you might wonder, if the memory accumulation story is giving us the *direction* of time and causation (E2), then what work

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<sup>137</sup> Remember, in §4.1.1 I explained that for every dimension there are two directions. But the question about time having a direction is whether one of those two directions is special or privileged.

is the causal theory (E1) doing? Here is where I remind the reader that the overarching goal of the project is to ask what we must accept about time if we take the definition of time-travel established in Chapter One. Using a causal theory of time gives us a nice story about what is going on in backwards time-travel cases (as per §5.1) and allows us to retain some of the features of the strong notion of time-travel, such as personal identity over time, avoiding causation at a temporal distance, and utilising local time. So, the reduction of time to causation is central to the project here.<sup>138</sup> I do not want memory accumulation (but rather, causation) to be the fundamental feature here. This is because the way our memories accumulate will in turn be dependent on certain facts about the laws of nature and the physical<sup>139</sup> structure of brains. Additionally, memory accumulation is being used to account for the experience of passage and the convention of assigning a direction to time (E2). It is not being used to account for some objective feature of the world, and hence we would not want to make some non-objective feature of the world fundamental. Causal direction (or at least, which we call cause and which we call effect is thus determined) is determined by memory accumulation, and that in turn determines which direction we call future and which past. But there is still an explanatory task, which is to explain why memory accumulation happens asymmetrically: why do we remember (or precognise) these things and not those things? The answer cannot be because these are the things that leave a causal trace (they cause the memories) because that would be circular, since we are appealing to memory to distinguish causes from effects. It seems that at some point there needs to be an asymmetry somewhere in the world to ground the asymmetries here. The answer is simply that it is a contingent fact that our brains are structured in certain way, and they interact with the world and the laws of nature, making it the case that we accumulate

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<sup>138</sup> Note again that I do not want to reduce the *direction* of time to the *direction* of causation. I mean that *other* facts about time reduce to facts about causation – but not facts about direction, as there is no temporal fact about direction. Whether or not this means that in a world without causation there would be no time will depend on whether one holds a relational or substantival view of time – See §4.4.3. If one holds a relational view there would be no time without causation. On a substantival view, time may still exist as a membrane or dimension, but without causation it would not be time-like in any meaningful sense.

<sup>139</sup> Assuming a reductionist account of mind is compatible with the backwards brains story.

memories in one direction and not the other. This is simply a contingent fact about the world, and the backwards-brains story highlights the fact that it could easily have been otherwise and we would perceive time and causation rather differently.

### **5.8. Local Time**

Here I will say something very briefly about what I mean by local time. A world that has local time is a world in which the (conventional) direction of time can be different in different regions of space-time. In such a world there will be regions of space-time in which a person would place the arrow of time in one direction, and were the same person placed in an adjacent region they would place the arrow in an opposite direction. Note that this is not a case where a person like us ('normal brained') places the arrow one-way and the backwards brain person places it the other way. In that case the discrepancy is due to the brain (or mind) of the person, not the external surroundings. Rather, what I mean is that the same person would place the arrow in different directions in different regions. In this case, the discrepancy is due to the external surroundings (events in time) and not the brain, nor some agent's position in time. Local time happens in some regions when those regions (two or more) of space-time have oppositely ordered events. The difference between the structure of events (or event parts) in the regions means that if we were to use some consistent method of placing an arrow on the regions, the arrows would be placed oppositely. This is different from what I have called a backwards brains case, in which the oppositely directed arrows are not due to any facts about the structure of events in time, but rather due to the agents' and their brains and orientation in time. Local time direction is a consequence of a view that *rejects* the idea that there is some fundamental and independent fact about the direction of time, and instead *endorses* the notion that the direction of time is given by the things (objects and events) *in* space-time. Thus, when the things in space-time are structured differently in different regions, this will have an effect on how direction is assigned to that region of space-time, and some regions will have direction assigned to them in a way opposite from how their neighbouring regions have direction assigned.

### **5.9. Chapter Conclusion**

In this chapter there have been two main foci. One has been the combination of time-travel with the causal theory, and the other has been the role of memory in attributing direction and passage to time. I defended the logical possibility of a reduction from the temporal to the causal because I foresaw that causal theories of time would, when applied to time-travel, provide tidy time-travel stories. I discussed this application both in this chapter and in Chapter Three. Working with an understanding of time on which the (assigned) direction of time and of causation do not come apart allows us to tell a time-travel story in which there is no backwards causation. This is helpful in turn because it allows there to be localised regions of time, and I have explained throughout the thesis that we should interpret Lewis' notion of personal time as a localised region of space-time, and not as somehow less than external time or real time. Using personal time as local time then allows us to ensure personal identity across time for the time-traveller because *their existence in* personal time is exactly analogous to their existence in external time. The time-traveller's personal identity is ensured through personal time, just as it is through external time because personal time *itself* is exactly analogous to external time.

As for the second focus, which is the memory or psychological account of attributed direction – it does not necessarily follow from the time-travel definition in Chapter One. In that sense, it may be thought that, in endorsing it, I am straying from my original question of what we must accept about time if we adopt my proposed definition. However, this is not quite so. If we accept the definition of time-travel that I have developed in Chapter One, then we must reject A-theoretic accounts of time, and adopt a B-theoretic account (Chapters One and Two). I argued in Chapter Four that since the B-theorist cannot appeal to the direction of the objective, moving present to assign a direction to time, they can only appeal to asymmetries in or of time. But I then showed that these asymmetries are not enough to assign direction (at least in any objective sense), and that there can be no objective direction on a B-theoretic picture. I endorse the view that we should accept a conventional account of direction. Of course, one might give a different conventional account of the direction of time than the conventional account that I have given. But I endorse an account which appeals to

psychological features of agents, such as memory, only because I think such an account is most promising. The memory account I endorse does follow as a consequence of the time-travel definition in Chapter One, but it does so indirectly.

# C Conclusion

The aim of this thesis was to look at the relationship between the philosophy of time-travel, the order and direction of time, and the order and direction of causation. I began by asking what we must accept about time if we accept the definition of time travel that I established in the first chapter. Primarily, I wanted to show that certain theories' commitments on issues regarding an objective, present moment and on issues regarding the direction of time would play a large role in determining the kinds of time-travel stories that would be compatible with the said theories.

I began by presenting an examination of the notion of time-travel which raised a number of considerations about how we define and understand such a concept. For example: causation and personal identity at a temporal distance; how to interpret personal time; and how to demarcate regular forwards directed existence from forwards directed time travel, are just some of the issues that were considered. I examined some (brief) attempts at definitions that others have made, and I proposed that we should employ an isolation, encapsulation, and exemption (IEE) requirement as the defining feature of time-travel. I then used this requirement, and my paradigm notion of time-travel, for the remainder of the thesis.

In Chapter Two I focussed on how we classify various theoretical positions in the philosophy of time, and I argued that we should reject A-theoretic views. This was to provide some foundations for what would follow in Chapter Three. There were two important conclusions that I drew from Chapter Two. The first was that there are at least two dichotomies in the philosophy of time. This fact is somewhat unrecognised, and this results in a complication of the discussions that take place in the philosophy of time. The two dichotomies are realism vs. anti-realism about moments other than the present (Eternalism vs. Presentism), and realism vs. anti-realism about the passage of an

objective present or NOW (A- vs. B-theories). The second important conclusion of the chapter was that the A-theories are inherently contradictory, as shown by McTaggart's Paradox. I showed that attempts to solve the paradox result in a reinstantiation of the same contradictions at another explanatory level.

In Chapter Three I combined the ideas that were presented in Chapters One and Two. I showed that A-theories are incompatible with the notion of time-travel from Chapter One. McTaggart's Paradox, which shows the incoherency of an objective moving present, is relevant in this chapter because I show that any attempts to make sense of A-theoretic time-travel result in a reinstantiation of the same problem at another level. This is exactly analogous to the structural form of McTaggart's paradox. Additionally, recognising that there are (at least) two dichotomies and not just one, as explained in Chapter Two, is also crucial to Chapter Three. This is because I highlight that it is the debate between A- and B-theories (or realism and anti-realism about the objective moving present), and not between Presentism and Eternalism as commonly thought, that is crucial to debates in the philosophy of time-travel. I presented what I believe to be an under-examined idea, namely that issues in the philosophy of time-travel are essentially bound up with issues in the direction of time and causation. Thus we cannot make time-travel from Chapter One compatible with an A-theoretic view of time.

Chapter Four focused on some philosophical issues on the problem of the direction of time. This followed on from Chapters One and Two because, on an A-theoretic view, the direction of time is given by the direction of the objective moving present, and this notion of the present is problematic. In this chapter, I argued that the B-theorists, since they reject the notion of an objective moving present, cannot appeal to it to give an objective direction of time. I showed that at most the B-theorists can appeal to asymmetries in/of time to account for differences in the two directions in time, but not that these asymmetries can give a way to demarcate one of the two directions as *the* direction of time. I then discussed the thermodynamic/entropic account and motivated some arguments against it, while I explained the causal account of the direction of time, and motivated some arguments *for* it.

The final chapter, Chapter Five, combined the conclusions from the previous chapters. I explained that an account on which the direction of time is a mere convention, rather than an objective feature of the world given by certain physical or metaphysical facts, is most the promising option for the B-theorist. In particular, I endorse the idea that an account which appeals to certain psychological features, especially memory accumulation, works well. I made some suggestions as to how the B-theorist might account for the *experience* of the passage and direction of time, given that I have argued there is no *objective* passage or direction. To account for the *experience* of passage and direction I appealed again to certain psychological features such as memory accumulation. I also reiterated the relevance of the direction of time and causation to issues in the philosophy of time-travel. For example, I showed that by employing a causal theory of time – one in which the (assigned) direction of time and of causation do not come apart – we can tell a tidy time-travel story that easily satisfies the requirements of our definition from Chapter One. I explained that, given this combination, backwards time-travel stories need not involve backwards causation, nor causation at a temporal distance, and that we can understand personal time as local time, and not anything less than external time. Using a theory on which the directions of time and causation cannot come apart allows the B-theorist to tell a ‘strong’ time-travel story.

This thesis has shown that issues in the philosophy of time-travel are not principally about the Presentist and Eternalist debate. Such issues are also, and *importantly* too, tied up with the A- and B-theory debate, i.e. with the debate surrounding realism and anti-realism about the notion of a single, objective, moving present moment. Consequently, we saw that issues around the direction of time play an important role in time-travel stories. Additionally, I showed that the commitments one holds on the direction of time will influence the time-travel story that one is able to tell, as well as which time-travel definitions such a story might be able to satisfy.





# References

- Aronszajn, Mark. 1996. "A Defense of Temporalism." *Philosophical Studies*.
- Baron, Samuel, and Bradley Monton. 2013 manuscript. Presentist Perdurantism.
- Beall, Jc and Glanzberg, Michael. 2011. Liar Paradox. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta.  
<http://plato.stanford.edu/archives/fall2013/entries/liar-paradox/>.
- Beall, Jc. 2008. *Revenge of the Liar*. Oxford: Oxford University Press.
- Belnap, N, and M Green. 1994. "Indeterminism and the thin red line." *Philosophical Perspectives* no. 8:365-388.
- Bigelow, John. 1991. "Worlds Enough for Time." *Noûs* no. 25 (1):1-19.
- 1996. "Presentism and Properties." *Noûs* no. 30:35-52.
- 2001. "Time Travel Fiction." In *Reality and Humean supervenience: essays on the philosophy of David Lewis*, edited by Gerhard Preyer and Frank Siebelt, 57-91. Rowan & Littlefield.
- Boltzmann, L. 1964. "Lectures on Gas Theory, 1896-1898."
- Bourne, Craig. 2006. *A future for Presentism*. Oxford Oxford University Press.
- Braddon-Mitchell, David. 2004. "How do we know it is now now?" *Analysis* no. 64 (3):199-203.
- Broad, C D. 1923. *Scientific Thought*. New York: Harcourt, Brace, and Co.
- Brogaard, Berit. 2012. *Transient Truths: An Essay in the Metaphysics of Propositions*. Oxford: Oxford University Press.
- Callender, Craig. 1997. "What is the 'Problem of the Direction of Time'?" *Philosophy of Science* no. 64:223-234.
- 2000. "Shedding Light on Time." *Philosophy of Science* no. 67:S587-S599.
- 2008. "The Common Now." *Philosophical Issues* no. 18:339-361.
- 2011. Thermodynamic Asymmetry in Time. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta.  
<http://plato.stanford.edu/archives/fall2011/entries/time-thermo/>.

- 2012. "Time's Ontic Voltage." In *The Future of The Philosophy of Time*, edited by Adrian Bardon. New York: Routledge.
- Carroll, Lewis. 1871. *Through the Looking Glass*. London: Macmillan.
- Cartwright, Nancy. 2007. *Hunting Causes and Using Them: Approaches in Philosophy and Economics*: Cambridge University Press.
- Craig, William Lane. 1998. "McTaggart's paradox and the problem of temporary intrinsics." *Analysis* no. 58 (2):122-127.
- 1999. "Oaklander on McTaggart and intrinsic change." *Analysis* no. 59 (4):319-320.
- 2001. "McTaggart's Paradox and Temporal Solipsism." *Australasian Journal of Philosophy* no. 79 (1):32-44.
- Crisp, Thomas. 2003. "Presentism." In *The Oxford Handbook of Metaphysics*, edited by Michael J. Loux and Dean W. Zimmerman, 211-245. Oxford: Oxford University Press.
- 2007. "Presentism and the grounding objection." *Noûs* no. 41:118-137.
- 2010. "Presentism and Grounding." In *Presentism: Essential Reading*, edited by Ernâni Margalhães and L. Nathan Oaklander. Lexington Books.
- Dainton, Barry. 2010. *Time and Space*. Second ed. Montreal: McGill-Queen's University Press.
- Daniels, Paul. 2013 manuscript. *Eternalist Endurantism*. Melbourne: Monash University.
- Daniels, Paul R. 2012. "Back to the Present: Defending Presentist Time Travel." *Disputatio* no. 4 (33):469-484.
- Davies, Paul. 2005. *About Time: Einstein's Unfinished Revolution*. London: Simon & Schuster Paperbacks.
- Dempsey, Sarah-Jane. 2014. *The Dynamic Present: Not yet an Ontology of the Past*, Philosophy Department, Monash University, Melbourne.
- Dickens, Charles. 1843. *A Christmas Carol*: Chapman & Hall.
- Dowden, Bradley. 2011. Time. *Internet Encyclopedia of Philosophy*, [www.iep.utm.edu/time/](http://www.iep.utm.edu/time/)
- Dowe, Phil. 1996. "Backwards Causation and the Direction of Causal Processes." *Mind* no. 105 (419):467-474.
- 2000. "The Case for Time Travel." *Philosophy* no. 75 (3):441-451.

- 2009. "Every Now and Then: A-Theory and Loops in Time." *The Journal of Philosophy* no. 106 (12):641-665.
- Dummett, Michael. 1964. "Bringing about the past." *The Philosophical Review* no. 73 (3):338-359
- 1969. "The Reality of the Past." *Proceedings of the Aristotelian Society* no. 69:239-258.
- Dyke, Heather. 2002. "McTaggart and the Truth about Time." In *Time, Reality and Experience*, edited by Craig Callender.
- Earman, John. 1974. "An Attempt to Add a Little Direction to "The Problem of the Direction of Time"." *Philosophy of Science* no. 41 (1):15-47.
- Everett, Allen, and Thomas Roman. 2012. *Time Travel and Warp Drives: A Scientific Guide to Shortcuts through Time and Space*. Chicago: University of Chicago Press.
- Faye, Jan. 2010. Backward Causation. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta.  
<http://plato.stanford.edu/archives/spr2010/entries/causation-backwards/>.
- Feynman, Richard. 1964. *The Feynman Lectures on Physics*.
- 1994 [1965]. "The Distinction of Past and Future." In *The Character of Physical Law*. Modern Library, Random House.
- Forrest, Peter. 2005. "The Real But Dead Past: A Reply to Braddon-Mitchell." *Analysis* no. 64 (4):358-362.
- 2006. "Uniform grounding of truth and the Growing Block theory: a reply to Heathwood." *Analysis* no. 66 (2):161-163.
- Garrett, Brian. 2006. *What's this thing called Metaphysics?:* Routledge.
- 2011. *What is this thing called Metaphysics?* Second ed: Routledge
- Gilliam, Terry. 1995. *12 Monkeys*. USA: Universal Studios.
- Gödel, Kurt. 1949. "A Remark about the Relationship between Relativity Theory and the Idealistic Philosophy." In *Albert Einstein: Philosopher-Scientist*, edited by P. Schilpp. La Salle, Illinois.: Open Court.
- Gold, T. 1965. "The Arrow of Time." In *Time*, edited by S. T. Butler and H. Messel, 143-165. London: Pergamon Press.
- Grey, William (previously Godfrey-Smith). 1999. "Troubles with Time Travel." *Philosophy* no. 74:55-70.
- Grünbaum, Adolf. 1967. "The Anisotropy of Time." *The Monist* 200-226.

- Hafele, J. C., and Richard E. Keating. 1972. "Around-the-World Atomic Clocks: Predicted Relativistic Time Gains." *Science* no. 177 (4044):166-168.
- Harrison, Jonathan. 1971. "Dr. Who and the Philosophers or Time-Travel for Beginners." *Proceedings of the Aristotelian Society* no. 45:1-24.
- Hartshorne, C. 1956. "New Propositions and New Truths." *The Review of Metaphysics*.
- Hawking, Stephen. 1988. *A Brief History of Time: From the Big Bang to Black Holes*. London: Bantam Books.
- Heathwood, Chris. 2005. "The real price of the dead past: a reply to Forrest and to Braddon-Mitchell." *Analysis* no. 65 (3):249-251.
- Heinlein, Robert A. 1957. *The Door into Summer*. New York: Doubleday.
- Herek, Stephen. 1989. *Bill & Ted's Excellent Adventure*. USA: Orion Pictures.
- Hinchliff, Mark. 1996. "The Puzzle of Change." *Noûs* no. 30 (10):119-136.
- Hinckfuss, Ian. 1975. *The Existence of Space and Time*. Oxford: Clarendon Press.
- Horwich, Paul. 1987. *Asymmetries in Time: Problems in the Philosophy of Science*. Cambridge: MIT Press.
- 2009. "The Metaphysics of Now." In *Arguing about Metaphysics*, edited by Michael C. Rea, 151-166. Routledge.
- Hunter, Joel. 2004. Time Travel. *Internet Encyclopedia of Philosophy*.
- Keller, Simon, and Michael Nelson. 2001. "Presentists should believe in Time Travel." *Australasian Journal of Philosophy* no. 79 (3):333-345.
- Le Poidevin, Robin. 2003. *Travels in Four Dimensions: The Enigmas of Space and Time*. Oxford: Oxford University Press.
- 2005. "The Cheshire Cat Problem and Other Spatial Obstacles to Backwards Time Travel." *The Monist* no. 88 (3):336-352.
- Lewis, David. 1976. "The Paradoxes of Time Travel." *American Philosophical Quarterly* no. 13 (2):145-152.
- 1986. *On the Plurality of Worlds*. Oxford: Basil:Blackwell.
- Lovejoy, Arthur O. 1909. "The Obsolescence of the Eternal." *The Philosophical Review* no. 18 (5):479-502.
- 1910. "The Place of the Time Problem in Contemporary Philosophy." *The Journal of Philosophy, Psychology and Scientific Methods* no. 7 (25):683-693.
- MacBeath, Murray. 1982. "Who Was Dr Who's Father?" *Synthese* no. 51:397-430.

- Markosian, Ned. 2009. "A Defense of Presentism." In *Arguing about Metaphysics*, edited by Michael C. Rea, 127-150. Routledge.
- 2013. Time. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. <http://plato.stanford.edu/archives/fall2013/entries/time/>.
- Martinez, Manolo. 2011. "Travelling in Branching Time." *Disputatio* no. 4 (26):59-75.
- Maudlin, Tim. 2002. "Remarks on the Passing of Time." *Proceedings of the Aristotelian Society* no. 102 (New Series):259-274.
- 2007. *The Metaphysics within Physics*. Oxford: Oxford University Press.
- McCall, Storrs. 1994. *A Model of the Universe*. Oxford: Clarendon Press.
- McTaggart, J. M. E. 1993 [1927]. "The Unreality of Time." In *The Philosophy of Time*, edited by Robin Le Poidevin and Murray MacBeath, 23-34. Oxford University Press.
- Meiland, Jack W. 1974. "A Two-Dimensional Passgae Model of Time for Time Travel." *Philosophical Studies* no. 26:153-173.
- Mellor, D. H. 1995. *The Facts of Causation*. London: Routledge.
- 1998. *Real Time II, International Library of Philosophy*. London: Routledge.
- Menzies, Peter, and Huw Price. 1993. "Causation as a secondary quality." *British Journal for the Philosophy of Science* no. 44 (2):187-203.
- Merricks, Trenton. 1994. "Endurance and indiscernability." *The Journal of Philosophy* no. 91:165-184.
- Meyer, Ulrich. 2007. "The Presentist's Dilemma " *Philosophical Studies* no. 122:213-225.
- Miller, Kristie. 2005a. "Presentism, Eternalism and the Growing Block." In *A Companion to the Philosophy of Time*, edited by Adrian Bardon and Heather Dyke, 345-364. Wiley Blackwell.
- 2005b. "Time travel and the open future." *Disputatio* no. 1 (19):197-206.
- Monton, Bradley. 2003. "Presentists can believe in closed timelike curves." *Analysis* no. 63 (3):199-202.
- 2009. "Time Travel without Causal Loops." *The Philosophical Quarterly* no. 59 (234).
- 2011. "Prolegomena to any future physics-based metaphysics." In *Oxford Studies in Philosophy of Religion*, edited by J. Kvanvig, 142-165. Oxford: Oxford University Press.
- Morris, M, and K Thorne. 1988. "Wormholes in Spacetime and Their Use for Interstellar Travel." *American Journal of Physics* no. 56:395-412.

- Muis, Remko. 2005. "Review of Four-Dimensionalism: An Ontology of Persistence and Time." *Ars Disputandi* no. 5.
- Niffenegger, Audrey. 2004. *The Time Traveler's Wife*. London: Vintage.
- Noonan, Harold. 2013. "Presentism and Eternalism." *Erkenntnis* no. 78 (1):219-227.
- Norton, John. 2010. "Time Really Passes." *Humana.Mente: Journal of Philosophical Studies* no. 13:23-34.
- 2011. The Hole Argument. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. <http://plato.stanford.edu/archives/fall2011/entries/spacetime-holearg/>.
- Oaklander, L. Nathan. 1993. "On The Experience of Tenseless Time." *Journal of Philosophical Research* no. 18:159-166.
- 1994. "Bigelow, Possible Worlds, and the Passage of Time." *Analysis* no. 54 (4):244-248.
- 1999. "Craig on McTaggart's Paradox and the problem of temporary intrinsics." *Analysis* no. 59 (4):314-318.
- Pal, George. 1960. *The Time Machine*. United States: Metro-Goldwyn-Mayer.
- Parsons, Josh. 2005. "Truthmakers, the Past and the Future." In *Truthmakers: The Contemporary Debate*, edited by Helen Beebe and Julian Dodd. Oxford: Oxford University Press.
- Paul, L.A. 2010. "Temporal Experience." *The Journal of Philosophy* no. 107 (7):333-359.
- Percival, Philip. 2002. "A Presentist's Refutation of Mellor's McTaggart." *Royal Institute of Philosophy Supplement* no. 50:91-118.
- Price, Huw. 1991. "Agency and Probabilistic Causality." *British Journal for the Philosophy of Science* no. 42 (2):157-176.
- 1992. "Agency and Causal Asymmetry." *Mind* no. 101 (403).
- 1995. "Cosmology, Time's Arrow, and That Old Double Standard." In *Time's Arrows Today: Recent Physical and Philosophical Work on the Direction of Time*, edited by Stephen Savitt. Cambridge University Press.
- 1996a. "Backwards Causation and the Direction of Causal Processes: Reply to Dowe." *Mind* no. 105 (419):467-474.
- 1996b. *Time's Arrow and Archimedes' Point*. New York: Oxford University Press.
- 2009. "The Flow of Time." In *The Oxford Handbook of Time*, edited by Craig Callender. Oxford: Oxford University Press.

- Price, Huw, and Brad Weslake. 2009. "The Time-Asymmetry of Causation." In *The Oxford Handbook of Causation*, edited by Helen Beebe, Christopher Hitchcock and Peter Menzies. Oxford: Oxford University Press.
- Prior, Arthur. 1967. *Past, Present and Future*. Oxford: Oxford University Press.
- 1968. *Papers in Time and Tense*. Oxford: Oxford University Press.
- 1993 [1968]. "Changes in Events and Changes in Things." In *The Philosophy of Time*, edited by Robin Le Poidevin and Murray MacBeath, 35-46. Oxford University Press.
- Prosser, Simon. 2007. "Could We Experience the Passage of Time?" *Ratio* no. 20 (1):75-90.
- Rea, Michael C. 2003. "Four Dimensionalism." In *The Oxford Handbook of Metaphysics*, edited by Michael J. Loux and Dean W. Zimmerman, 246-280. Oxford: Oxford University Press.
- Reichenbach, Hans. 1956. *The Direction of Time*: The University of California Press.
- 1958 [1928]. *The Philosophy of Space and Time*. New York: Dover Publications.
- Richard, Mark. 1981. "Temporalism and Eternalism." *Philosophical Studies* no. 39 (1):1-13.
- Roach, John. 2007. Antifreeze-Like Blood Lets Frogs Freeze and Thaw With Winter's Whims. *National Geographic News*,  
<http://news.nationalgeographic.com/news/2007/02/070220-frog-antifreeze.html>.
- Roache, Rebecca. 1999. "Mellor and Dennett on the Perception of Temporal Order." *Philosophical Quarterly* no. 50 (195):231-238.
- Rowling, J. K. 2000. *Harry Potter and The Goblet of Fire*: Bloomsbury.
- Russell, Bertrand. 1915. "On The Experience of Time." *The Monist* no. 25 (2):212-233.
- Schaffer, Jonathon. 2009. "Spacetime the one substance." *Philosophical Studies* no. 145:131-148.
- Schlesinger, George. 1994. "The Stream of Time." In *The New Theory of Time*, edited by L. Nathan Oaklander and Quentin Smith, 256-285. Hartford: Yale University Press.
- Shoemaker, Sydney. 1969. "Time Without Change." *The Journal of Philosophy* no. 66 (12):363-381.
- Sider, Theodore. 2000. "The Stage View and Temporary Intrinsics." *Analysis* no. 60 (1):84-88.



- 2001. *Four-Dimensionalism: An Ontology of Persistence and Time*: Oxford.
- 2005. "Travelling in A- and B- Time." *The Monist* no. 88:329-335.
- Skow, Bradford. 2012. "Why Does Time Pass?" *Noûs* no. 46 (2):223-242.
- Smart, J. C. C. 1969. "Causal Theories of Time." *The Monist* no. 53 (3):385-395.
- Smeenk, Chris, and Christian Wüthrich. 2011. "Time Travel and Time Machines." In *The Oxford Handbook of Philosophy of Time*, edited by Craig Callender, 577-630. Oxford: Oxford University Press.
- Smith, Nicholas J. J. 2011. "Inconsistency in the A-Theory." *Philosophical Studies* no. 156 (2):231-247.
- 2013. Time Travel. In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. <http://plato.stanford.edu/archives/win2013/entries/time-travel/>.
- Tooley, Michael. 2000. *Time, Tense and Causation*. Oxford: Oxford University Press.
- 2013 manuscript. Causation. <http://spot.colorado.edu/~tooley/Causation.html>.
- Von Bretzel, Philip. 1977. "Concerning a Probabilistic Theory of Causation Adequate for the Causal Theory of Time." *Synthese* no. 35.
- Vranas, Peter B. M. 2005. "Do cry over spilt milk: Possibly you can change the past." *The Monist* no. 88:370-387.
- Wells, H. G. 1895. *The Time Machine*. U.K.: William Heinemann.
- Wells, Simon, and Gore Verbinski. 2002. *The Time Machine*. United States: DreamWorks Pictures, Warner Bros. Pictures.
- Williams, Donald C. 1951. "The Myth of Passage." *The Journal of Philosophy* no. 48 (15):457-472.
- Williamson, Timothy. 2013. *Modal Logic as Metaphysics*. Oxford: Oxford University Press.
- Zemeckis, Robert. 1985. *Back to the Future*. USA: Universal Pictures.
- Zimmerman, Dean W. 2005. "The A-Theory of Time, The B-Theory of Time, and 'Taking Tense Seriously' " *Dialectica* no. 59 (4):401-457.