Symmetric and Asymmetric Theories of Time

Abstract

There is a feeling of dissatisfaction with the traditional way of defining the A-theories of time. One reason is that these definitions rest on an ontological question – 'Do the future and the past exist?' – to which no non-speculative answer can be provided. Another reason is that these definitions fail to distinguish between various A-theories of time *at all times* and, therefore, cannot be regarded as essential to them. In the present paper, I make a fresh start in the debate, by introducing two questions whose specific answers allow one to get a comprehensive categorization of the A-theories of time. This alternative way of defining the A-theories of time addresses the two above-mentioned issues and reveals the metaphysical singularity of underrated theories, such as the growing block theory.

1. Introduction

In the present paper, I argue that the traditional way of defining the A-theories of time – in terms of whether the future and the past exist – should be abandoned. To make that case, I argue that whereas nothing in actual intuition answers to the question 'Do the future and the past exist?', we clearly intuit that the future *differs* from the past (e.g., causes occur prior to their effects, the arrow of time points from past to future, the future is open while the past is fixed, etc.). My proposal in this paper is therefore to make a fresh start in the debate by distinguishing two groups of A-theories of time: the *asymmetric* theories that have *intrinsic* resources to explain *why* (at least some) past-future time differences are intuited, and the *symmetric* theories that need *extrinsic* resources (e.g., entropy).[1] I then distinguish the various forms *symmetric* and *asymmetric* theories may adopt by introducing two dynamic principles: *Temporal Becoming* and *Annihilation*. This proposal has many benefits. First, it offers an illuminating and comprehensive categorization of the A-theories of time. Secondly, it restores the role that our intuitions should play in the debate, by putting the focus on theoretical features that can be evaluated through non-stipulative methods. Thirdly, it reveals the metaphysical singularity of GBT, which does no longer represent a hybrid between two polar opposite views (eternalism and presentism), but a real alternative to two symmetric theories.

The paper is structured as follows. In the second section, I present the traditional, ontological way of introducing the A-theories of time. I start from the McTaggartian distinction between the A- and the B-series, two ways of ordering positions in time. I then

[1] In what follows, the distinction between *symmetric* and *asymmetric* A-theories of time will only concern flat spacetimes. The implications of General Relativity on the geometry of spacetime will not be discussed in the paper.

introduce, as tradition dictates, the various A-theories of time as so many potential answers to the question 'Do the future and the past exist?'. In the third section, I express my dissatisfaction regarding the traditional way of defining the A-theories of time, since (i) it neglects the role our intuitions should play in the debate, and (ii) it fails to distinguish between various A-theories of time *at all times*. In the fourth section, I make a fresh start in the debate by introducing two questions whose specific answers allow (i) to get a comprehensive categorization of the A-theories of time, (ii) to address the two above-mentioned issues, and (iii) to reveal the metaphysical singularity and the potential of GBT.

2. The McTaggartian Picture

In his best-known paper published in 1908, J.M.E. McTaggart argues that time is unreal, because our descriptions of time are either *insufficient*, *contradictory* or generates a *vicious circle* or an *infinite regress*. McTaggart begins his argument by distinguishing two ways of ordering positions in time. First, positions can be ordered according to their possession of properties like *being two days past*, *being present*, *being one day future*, etc. – these properties are often referred to now as 'A-properties'. McTaggart calls the series of positions ordered by these properties the 'A-series'. Secondly, positions in time can be ordered by two-place relations like *two days earlier than*, *simultaneous with*, *one day later than*, etc. – these relations are often referred to now as 'B-relations'. McTaggart calls the series of positions ordered by these relations the 'B-series'.[2] This distinction between the A-series and the B-series has served as a natural starting point for most of subsequent work on the metaphysics of time. In particular, it has offered a framework within which the main theories of the temporal structure of the world have since been developed.

Nowadays, philosophers of time are said to hold an 'A-theory of time' or a 'B-theory of time', depending upon their attitudes to the A-properties and B-relations. These labels, first coined by Richard M. Gale (1966), can be understood as follows: the 'A-theorists' (or 'tense realists')[3] claim that there is an objective distinction between what is past, present or future, while their opponents, the 'B-theorists' (or 'tense anti-realists')[4] deny the objectivity of any such distinction. To put it another way, A-theorists and B-theorists agree that every thing in

[2] While both of these series are essential for the reality of time, the A-series is the more fundamental of the two, since the B-series can be derived from it alone (cf. McTaggart 1908: 463).
[3] Cf. Bigelow, 1996; Broad, 1923; Cameron, 2015; Chisholm, 1990a, 1990b, 1981; Correia & Rosenkranz, 2018; Craig, 2000; Crisp, 2003, 2004; Forrest, 2005; Geach, 1972; Lowe, 1998, Ch. 4; Lucas, 1989; Markosian, 2004; McCall, 1994; Merricks, 1999; Prior, 1970, 2003; Tooley, 1997; Zimmerman, 1996, 1998, 1997.
[4] Frege, 1984 (see esp. p. 370); Grünbaum, 1967, Ch. 1; Le Poidevin, 1991; Lewis, 1986; Mellor, 1981, 1998; Quine, 1960, §36; Russell, 1903, Ch. 54; Saunders, 2002; Savitt, 2000; Sider, 2001; Smart, 1963, Ch. 7, 1987.

time is 'past relative to' some things, 'future relative to' others, and 'present relative to' itself – just as every place on earth is south relative to some places, north relative to others, and at the same latitude as itself. But, whereas B-theorists regard this spatial analogy as deeply revelatory of the purely relative nature of the division of time, A-theorists claim that it is misleading. According to A-theorists, every thing in time that is past, present, or future in a merely relative sense is, in addition, past, present or future in a *non*-relative sense (i.e. past, present, or future *simpliciter*) (cf. Zimmerman 2011: 163-164).

Although there is an ongoing debate about whether there is a genuine metaphysical conflict between the A- and the B-theory of time,[5] it is generally accepted that these two theories draw their legitimacy from different sources of evidence: whereas the A-theory seems backed by our intuitions, the B-theory is favored by the scientific community.[6] More specifically, the A-theorist generally emphasizes that her theory can account for *how* we ordinary think of time: (i) time has a direction,[7] (ii) 'our present' extends throughout the universe, (iii) the future is open whereas the past is fixed, etc.[8] By contrast, the B-theorist generally emphasizes that her theory can account for what science, especially contemporary physics, says about time: (i) time has no direction (since there is no objective sense in which time is flowing one way rather than the other), (ii) there is no unique present (since there is no absolute relation of objective simultaneity), (iii) there is no asymmetry in openness between the future and the past (since the 'block universe' view of time, which is favored by physicists, is *isotropic* and the fundamental laws of physics are *time-reversal invariant*), etc.[9]

While A-theorists usually share the same high concern for delivering a commonsense view of time, they disagree on whether all of reality is confined to the present. That is why it is common to define the different versions of the A-theory by how they answer to the question

[5] Cf. Williams 1996, 1998a, 1998b; Deng 2010; Oaklander 2001; Parsons 2002.

[6] It should be noted, however, that this way of framing the debate between the A- and the B-theory is properly contemporary (and perhaps partly misleading). As one of my reviewers rightly pointed out, historically, the B-theory has often been motivated by theological considerations, or Platonism, whereas the A-theory has been motivated by scientific arguments (particularly associated with the life sciences).

[7] Even if no one (to my knowledge) has defended such a combination of views, it is possible to claim that time lacks an intrinsic direction but includes objective distinction between past, present and future (cf. Sider 2005).

[8] Important experimental philosophy papers have recently been published on temporal intuitions, e.g., Grush (2009, 2016), Eagleman (2011). Apart from the details, these papers show that the content of our temporal experience is not limited to sequences of static snapshots (as B-theorists generally conceive change), but gives immediate access to motion and genuine change. These results seem therefore to corroborate the claim that the A-theory of time is favored by the way time and change are pretheoretically apprehended.

[9] In this perspective, the A- and B-theory of time may both appear unsatisfying: the A-theory conflicts with science (especially with the Special and General theories of relativity), while the B-theory gives us no handle on time as universally experienced (especially in terms of an ongoing now) (cf. Baker 2010: 27).

'Do the future and the past exist?'.[10] According to the traditional definitions, *eternalism* and *presentism* are the two extreme answers that can be provided to that question: the former says that both the future and the past exist, whereas the latter says that neither the future nor the past exists. Intermediate between these two extreme answers are the *growing block theory* (GBT), which says that the past exists but the future does not exist (cf. Sider 2001: 12, Callender 2011: 3), and the *shrinking block theory* (SBT), which says that the future exists but the past does not exist. For example, as Caspar Hare puts it: "[s]ome imagine that the past exists but the future does not […]. Some imagine that the future exists but the past does not […] Presentists, meanwhile, hold that only present objects, events, moments exists (and perhaps things that exist timelessly, like gods and numbers). There are no past or future things" (2009: 17). However, there are some reasons to complain about this traditional way of defining the A-theories. Some of these reasons have already been identified in the literature, but some others, which may seem more important, still need to be discussed. In the next section, I propose to examine two new complaints: one concerning the stipulative nature of the traditional definitions, the other concerning their temporal contingency.

It must nevertheless be acknowledged that the ontological way of framing the A-theories of time, in terms of whether the future and the past exist, does not fully reflect the richness of the current debate. Many sophisticated views, such as McCall's (1994) shrinking tree, have been widely recognized as important features of temporal ontology. In that sense, although the eternalism-presentism distinction might appear dominant, it should not overshadow the fact that many philosophers have already proposed to reformulate the debate in order to capture the nuances it contains – some of these proposals will be discussed in the next section. The goal of reframing the debate is therefore not original in itself, but the reasons for which this reframing is undertaken in the present paper and the reframing itself are.

3. Complaining about the McTaggartian Picture

One may agree with Timothy Williamson (2013: 22) that there is a "feeling of dissatisfaction" with the eternalism-presentism distinction. The reason, he says, is that there is no satisfactory way to spell out what is meant by 'is present' in the traditional definition of presentism, according to which 'everything is present'.[11] There are indeed good reasons to reject all the

[10] This way of putting the question purposely remains general: 'the future' and 'the past' not only refer to instants, but also to events (e.g., WWI, the conquest of Mars) and things (e.g., Napoleon, my great grandson).

[11] As Thomas Crisp makes clear, "[t]his way of putting the thesis, or something close to it, is fairly common in the literature" (2004: 15). For instance, Merricks characterizes presentism as the view that "all that exists, exists at the present time" (1995: 523), and Bigelow as the view that "nothing exists which is not present" (1996: 45).

most plausible candidate interpretations. For example, consider the natural idea that "[…] to be present is just to be real or to exist" (Zimmerman 1996: 117). The problem with this interpretation is that it makes presentism trivially true: if presentism is to be interpreted as the thesis that 'everything exists', then everyone is a presentist! Another natural idea is to claim that to be present is to instantiate the primitive property of presentness. However, as Zimmerman himself concedes, "[…] no *real* presentist has any reason to believe in a special quality of 'being present'" (1996: 125). Moreover, as Daniel Deasy argues, this interpretation reduces the debate between A-theorists to the debate about whether everything or only something instantiates this property, which sounds like "[…] a parody of the philosophy of time" (2017: 383). Finally, Williamson mentions a third interpretation: "[…] something is present when and only when it is spatially located" (2013: 24). However, it is not clear that this interpretation would be false in a non-presentist setting (as it is meant to be) – there would, for instance, be nothing *prima facie* problematic in an eternalist's asserting that everything has a spatial location. Furthermore, this latter interpretation makes presentism incompatible with theories that have no ramification with the philosophy of time, such as the platonist theory that there are spatially unlocated abstract objects (e.g., numbers). Since the predicates 'is past' and 'is future' – as they appear in the other A-theories of time (eternalism, GBT and SBT) – are respectively defined in terms of 'to be *earlier* than the present things' and 'to be *later* than the present things', the mystery surrounding the term 'is present' seems to infect all the traditional definitions.[12]

Another issue raised by the traditional definitions of the A-theories of time has to do with the interpretation of the universal quantifier 'everything' (cf. Crisp 2004, Ludlow 2004, Meyer 2005, 2011, Sider 2006, Miller 2013). The question is whether, when presentists claim that 'everything is present', the quantifier is to be interpreted as tensed or tenseless. Both options seem problematic. If it is tensed, then presentism is the trivially true thesis that 'everything present is present' (which hence makes eternalism trivially false). If it is tenseless, then presentism is the trivially false thesis that 'everything past, present or future is present' (which hence makes eternalism trivially true). It therefore seems that presentism is either trivially true (and eternalism trivially false), or trivially false (and eternalism trivially true). In other words, it appears that the traditional way of defining the A-theories of time turns what is meant to be a metaphysical debate between two venerable positions – presentism and eternalism – into a purely semantic debate about *how* the universal quantifier in the definitions should be

[12] Williamson therefore proposes to abandon the eternalism-presentism distinction as "hopelessly muddled", and to get on with the clearer permanentism-temporaryism debate (cf. 2013: 25).

interpreted. This is what leads Ulrich Meyer, for instance, to conclude that "[…] there is no reading on which [presentism] expresses a substantial metaphysical truth" (2005: 213-214).

However, although it should be acknowledged that traditional definitions of the A-theories of time (i) make unclear what it is for something to be present, and (ii) threat the metaphysical nature of the eternalism-presentism debate, this is not what should concern us most. After all, following Williamson (2013), Correia and Rosenkranz (2018) have shown that presentism (and other A-theories) can be defined without using the mysterious notion of 'presentness'. In particular, they argue that presentism is the only theory that accepts both of the following principles: (P2) 'every time is new at itself' ($Tx \rightarrow \text{At } x, H\neg E!x$), and (P3) 'every time is last at itself' ($Tx \rightarrow \text{At } x, G\neg E!x$).[13] Furthermore, it is not clear that in using 'everything' in the tenseless way, presentists are saying something trivially false. As Correia and Rosenkranz (2015, 2018) have argued: just as saying that 'every black or non-black raven is black' is "[…] a perfect sound way of saying that the only raven that exist are black", saying that 'everything past, present or future is present' is "[…] a perfect sound way of saying that the only things in time that exist are present – and this will remain to be so even if what is present may also be past or future" (2018: 62). For his part, Deasy (2017: 381) argues that there is a natural reading of the traditional definition of presentism on which it expresses a thesis which is neither trivially true nor trivially false: '$\mathbf{A}\ \forall x\ \mathit{Present}(x)$', where '**A**' stays for 'always' and '$\forall x$' is the universal quantifier of classical first-order logic and is, following Barcan (1962), neither tenseless nor tensed.

Rather, the main problem with the traditional way of defining the A-theories of time is that it rests on an ontological question – 'Do the future and the past exist?' – while we have no strong intuitions thereon.[14] A-theories of time are indeed meant to match the ordinary

[13] Another possibility is Daniel Deasy (2017), who claims that presentism should be identified with the only A-theory which accepts *Transientism*, i.e. the principle that 'Sometimes, something begins to exist and sometimes, something ceases to exist'.

[14] This claim has been challenged. Jerome J. Valberg (2012), for instance, argues that we could not say about an entity (e.g., Socrates) that it has disintegrated, because Socrates will always remain as a possible object of reference. This suggests, Valberg claims, that once something exists or has being, it cannot lose it – the being of an entity is irrevocable. However, this argument rests on a peculiar theory of reference, which trivializes the existence of the past (and therefore makes presentism and SBT trivially false). A more plausible (and actually popular) view is the so-called 'causal theory of reference', according to which (i) a name's referent is fixed by an original act of naming, and (ii) subsequent uses of that name succeed in referring to that referent by being linked to the original act of naming via a causal chain (cf. Kripke 1980). As Marga Reimer, for instance, puts it: "[...] speakers thus effectively 'borrow' their reference from speakers earlier in the chain, though borrowers needn't be able to identify any of the lenders they are in fact relying on" (2019: §2.2). Taking this view seriously, it seems that the fact that Socrates no longer exists does not imply that the reference-link is broken. Although Socrates has long since disintegrated, we can still successfully refer to him. The reason is that *our act of referring* is causally linked to the original naming of Socrates (by which 'Socrates' became a rigid designator). Socrates (via his initial baptism) is at the origin of a causal chain (which ensures that later uses of the name 'Socrates' succeed in referring to him), although he no longer exists.

intuitions we have regarding the nature of time (e.g., time flows uniformly and universally, our 'present' extends throughout the universe, the future is open while the past is fixed, etc.), and if we define these theories in terms of whether the future and the past exist, then we risk simply missing the point. For instance, a statement such as ˹The conquest of Mars exists˺ can neither be confirmed nor refuted by any intuition or experience whatsoever. As Clifford Williams puts it: "[…] there is no experiential way to differentiate between [events] being equally real and not being equally real" (1998: 386); the only events we experience are the ones occurring at the time of our experience, whether this be in eternalist or in presentist settings. For his part, Craig Callender compares the eternalism-presentism debate to two people arguing about whether the refrigerator lightbulb go out when the door is shut: "'Refrigerator presentists' believe the light is off when the door is shut; 'refrigerator eternalists' believe the light remains on" (2000: 588). This debate is pointless since, barring drilling a hole into the side of the refrigerator, we can only check the light by opening the door (while this will not test either hypothesis).[15]

A reply might be that empirical science, especially observational astronomy, is precisely what allows us to drill a hole into the side of the refrigerator and, therefore, to determine *who* of the eternalists or the presentists are right. For example, it might seem that the recent observation of gravitational waves speaks in favor of eternalists, since this observation informs us about the very early universe. But, as it should be clear, all that the observation of gravitational waves allows us to conclude is that the past existed (not that the past is still existing), while this is compatible with both eternalist and presentist theories. When we observe gravitational waves, we do not observe the past (or only in a metaphorical sense); we observe disturbances in the curvature of spacetime that, although they emerge from the very early universe (and might therefore offer a unique probe to explore it), are *simultaneous* with our observation. So, even empirical science – with its powerful instruments and super sensitive detectors – only allows us to observe events that occur at the time of our observation. It therefore seems hopeless to appeal to empirical data in order to settle the debate between eternalists and presentists.

To the question 'Do the future and the past exist?', we thus have no pre-theoretical answer. The dispute between eternalists and presentists cannot be solved by means of intuition

[15] There is, of course, a sense in which we do experience earlier and later events: when we were at past times, we experienced the events occurring then, and when we will arrive at future times, we will experience the events occurring then. But this is true in both eternalist and presentist settings, so that this does not provide a clear-cut answer to the question as to whether the future and the past exist (cf. Williams 1998: 386).

– that is probably *why* this dispute may appear so stipulative (cf. Williams 1998, Callender 2000, Dorato 2006, Savitt 2006). Of course, this does not mean that it is *false* to say that the various A-theories of time differ with respect to how they answer to the question 'Do the future and the past exist?'. For instance, it is usually *right* to say that eternalists hold that both the future and the past exist, while presentists hold that neither the future nor the past exist. What I ultimately want to argue is that, since these definitions can neither be confirmed nor refuted pre-theoretically, they cannot be *essential* to the A-theories, i.e. they cannot be true in virtue of *the nature* of the A-theories, which are primarily meant to match our ordinary intuitions on time. Of course, one could object that matching (at least some of) our intuitions should not be A-theorists' primary concern; but, if so, then it is not clear *why* one should not adopt a B-theory of time which, as has been said, has the advantage of being favored by the scientific community. As a reminder, the theories of relativity seem to imply a static view of time, in which past, present and future are equally real (the 'block universe' view of time).

This approach could be criticized for ascribing more weight to intuitions than they can actually bear. After all, the controversy between A-theorists of time is primarily a metaphysical one, not an experiential one. The answer, it seems to me, is that there are several kinds of metaphysical controversies. Admittedly, many metaphysical controversies cannot be solved solely by appeal to experience. For example, if one wants to challenge Williamson's claim that vagueness is a form of ignorance (cf. Williamson 1994), one will not deny that we experience some borderline cases; it is something that both Williamson and his critic agree upon. What one will criticize is rather Williamson's inference from this experience, namely that there are sharp boundaries but we are unable to figure out their exact location. However, there are also metaphysical controversies that are more closely connected to experience. For example, Whitehead ([1934] 2011) argues that if we look carefully at our experience, we will find that fundamental concepts are not Aristotelian substances but activity and process: temporal entities are what we experience as basic, not concrete objects (which are regarded to be composites of many occasions of experience). If Whitehead is right, then the conflict between these two ontologies is "[…] decidable more by probing our experience than by making inferences from them" (Williams 1998b: 391).

The debate on the nature of time seems more like the second of these disputes than the first. In the first, we all agree that we experience borderline cases, but we do not appeal to any experience to state whether these cases are ontic, semantic or epistemic phenomena. It is the reverse with respect to the debate on the nature of time. Eternalism and presentism are not to be conceived as rival metaphysical explanations of one commonly agreed upon set of

experiences. They are indeed not inferred from a prior knowledge of the temporal structure of the world. Rather, the debate on the nature of time is (partially) about which theory experience confirms. For instance, it is common for A-theorists of time to argue that a particular version of the A-theory is true partly because it matches with *how* time is ordinary experienced (see, for example, Zimmermann 2008: §7). Experience is thus evidence for theories of time, not the other way around. Therefore, one can reject the traditional way of defining the A-theories of time, on the ground that the definitions can neither be confirmed nor refuted by experience, without jeopardizing the metaphysical nature of the debate. Some metaphysical debates are much more closely connected to experience than others, and the debate on the nature of time is presumably one of them.

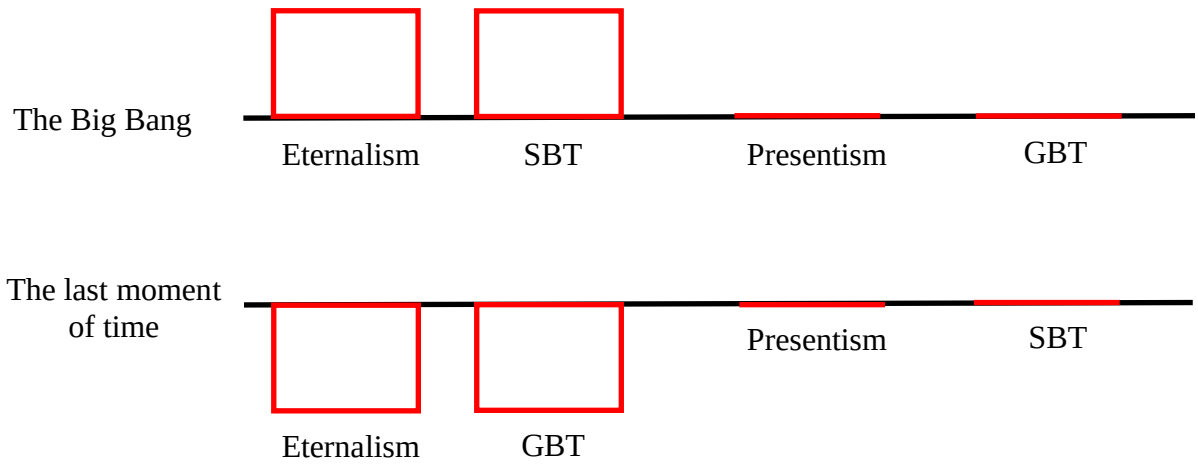
A second reason why traditional definitions should not be taken as *essential* to the A-theories is that there are some specific times at which they fail to distinguish between the theories in question. For example, at the start of the Big Bang (where there is no past), eternalism and SBT, as well as presentism and GBT, are ontologically indiscernible: eternalists and shrinking blockers are both merely committed to the existence of the present and the future ('everything is either present or future'), whereas presentists and growing blockers are both merely committed to the existence of the present ('everything is present'). Likewise, at the last moment of time (where there is no future), eternalism and GBT, as well as presentism and SBT, are ontologically indiscernible: eternalists and growing blockers are both merely committed to the existence of the past ('everything is past'), whereas presentist and shrinking blockers are both merely committed to the existence of the present ('everything is present') (cf. *Figure 1*).[16] Therefore, since the traditional definitions of the A-theories do not allow to distinguish between them *at all times*, it seems that they cannot be considered as *essential* to them. After all, the following principle looks plausible: if there is at least one time *t* at which the definition *D* fails to singularize *x*, then *D* is not true in virtue of *x*'s nature, i.e. *D* is not *essential* to *x*.

Thus, the fact that the traditional way of defining the A-theories of time (i) neglects the role that intuitions are meant to play in the debate on the nature of time, and (ii) fails to distinguish between the A-theories *at all times*, suggests that the A-theories should be introduced differently. In the next section, I therefore propose a fresh way of singularizing the A-theories of time, by introducing two questions – 'Is there a geometric asymmetry between

[16] Admittedly, this second objection does not succeed if the A-theories of time are defined as claims of type 'Always, …'. For, if presentism says 'Always, what exists is what is present', then, even at the start of the Big Bang, presentism and GBT are distinguishable.

the future and the past?' and 'Is temporal becoming (i.e. the creation of new things in the present) real?' – whose respective answers can be pre-theoretically evaluated. When these answers are super-imposed, they allow one to get a comprehensive categorization of the A-theories of time. One immediate consequence of this proposal is that GBT will no longer represent a hybrid between eternalism and presentism, but a theory in its own right, which seems better designed than its rivals to accommodate some of our intuitions. It must nevertheless be acknowledged that, although GBT and SBT are marginalized by the traditional way of framing the A-theories of time, they have been defended in important and recent publications. Concerning GBT, one can mention Briggs & Forbes (2012, 2017, 2019), Deng (2017), Correia & Rosenkranz (2013, 2018), and Grandjean (2021). Concerning SBT, publications are rarer, but one can still mention Casati & Torrengo (2011) and Norton (2015).

Figure 1



4. The McTaggartian Picture revisited

As has been said, we have no intuition as to whether the past and the future exist. But an intuition that we surely have regarding the nature of time is that the future *differs* from the past. For example, causes occur prior to their effects, the arrow of time points from past to future, the future is open while the past is fixed, etc. Of course, it could be argued that these past-future time differences have nothing to do with the temporal structure of the world. For example, it has become increasingly popular to claim that these differences are to be explained by physical phenomena, such as the increase in entropy. Lawrence Sklar, for instance, claims that "[w]here there is no local entropic asymmetry, there is no future-past of time" (1992: 149). However, this kind of Reichenbach-inspired approaches at best postpones the problem: given that there is no directedness in fundamental physics – the popular 'block universe' view

of time is *isotropic* (spacetime has no intrinsic direction), and the fundamental laws of physics are *time-reversal invariant* (they do not distinguish the future-direction from the past-direction) – where does the thermodynamic asymmetry in time come from?[17]

A more promising approach, the so-called *Time Direction Heresy*, which was originally put forward by John Earman (1974), is to argue that 'temporal orientation' (understood as a thicket of differences between the future and the past) cannot be reduced to non-temporal features.[18] Tim Maudlin (2002, 2007), for instance, explicitly adopts this approach when he argues that a wide variety of time-asymmetries (including the passage of time and the direction of time) are ultimately grounded in the intrinsic time-asymmetry of the universe. Another example is George Ellis (2006, 2013), who argues that the various arrows of time (e.g., the passage of time, the openness of the future) derive from an evolving block universe. In short, the *Time Direction Heresy* takes our intuition that the future differs from the past *seriously*, i.e. as reflecting the deep structure of reality. This approach bridges the gap between *phenomenal* and *physical* time by taking some of our intuitions as reliable indicators of how reality truly is. A proposal would therefore be to abandon the traditional debate (since there are no pre-theoretical reasons to adopt either eternalism or presentism), and to make a fresh start with a clearer distinction between two groups of A-theories of time: those that have intrinsic resources to explain *why* (at least some) differences between the future and the past are intuited, and those that need extrinsic resources (e.g., entropy).

This proposition immediately raises a question: 'What does 'intrinsic' mean here?' Roughly, an A-theory has intrinsic resources to explain *why* (at least some) differences between the future and the past are intuited if (and only if) the spatiotemporal structure it describes encodes a relevant past-future time asymmetry in its geometric features. To understand this, it is crucial to reconceptualize the A-theories as primarily describing contentless geometric constructions, whose features do not refer to objects antecedently given (by some sort of experience or prior knowledge) but only have a purely 'formal-logical' meaning stipulated by some primitive axioms (which therefore serve as implicit definitions).[19]

[17] For a detailed discussion on this point, see Grandjean 2021.

[18] To be precise, Earman does not unequivocally endorse the *Time Direction Heresy*, but argues that no convincing arguments against it could be found in the very extensive literature.

[19] This 'conventionalist' geometry (which essentially makes no reference whatsoever to any kind of extra-formal content) should not be confused with applied (or physical) geometry, which attempts to "[…] coordinate such uninterpreted formal system with some domain of physical facts given by experience" (Friedman 2002: 121). For example, according to the general theory of relativity, the geometry of physical space is another physical field (the field mediating specifically gravitational interactions): "[w]hether a given region of physical space is Euclidean or non-Euclidean depends on the distribution of matter and energy" (Friedman 2002: 122). That is what led the physicist H. P. Robertson to famously conclude that geometry has become a branch of physics (cf. 1949: 315-332).

In that sense, A-theories of time are not empirical constructions, but result from irreducibly theoretical choices: they primarily outline geometric structures in which individuals (e.g., spacetime points, events and objects) participate. Of course, this does not prevent A-theories from being subsequently confirmed (or refuted) by experience; it is even a crucial step! But, as has been said, experience is to be understood as evidence for the A-theories of time, not the other way around.

There are reasons to believe that the geometric structures described by the A-theories are *fundamental*, in the sense of not being dependent on sets of spacetime points, events or objects. Against a powerful tradition, which takes spacetime geometry to be a system of external relations that supervenes on spacetime points, the idea is that spatiotemporal structures are ontologically primary, while individuals (such as spacetime points, events and objects) have a mere derivative status. This 'structuralist' view is directly inspired from an influent current in the philosophy of science, sometimes called Ontic Structural Realism (OSR), which inflates the ontological priority of structure and relations.[20] However, whereas OSR is generally motivated by the interpretation of quantum physics (cf. Ladyman & Ross 2007), the present structuralist view is motivated by the nature of the A-theories itself. Once again, A-theories are not set up from objects antecedently given; they primarily outline geometric background structures, whose properties are stipulated by some primitive axioms. Therefore, taking A-theories seriously (i.e. as saying something about *how* time truly is), it is natural to regard the background structures they outline as fundamental and, thus, as ontologically prior to the individuals that participate within them. As a result, although some important geometric features of the spatiotemporal structures can hardly be expressed with no reference to individuals (such as spacetime points, events and objects), one has to keep in mind that these individuals only play a *heuristic* role: they allow for the description of geometric structures which then carry the ontological weight.

Given this 'geometric' reconceptualization of the A-theories of time, 'the non-token-relative present' (or 'the present', thereafter) can be regarded as an axis around which some transformations can be operated.[21] In particular, in the Euclidean plane, reflection symmetry

[20] OSR admits at least two forms: (i) *radical* – there are no individuals, but there is a relational structure (Ladyman 1998, French and Ladyman 2003), (ii) *moderate* – there are relations that do not depend on the intrinsic properties of their *relata* (Esfeld 2004, Esfeld and Lam 2008). However, the radical from of OSR is often criticized on the grounds that there cannot be relations without *relata* (cf. Cao 2003, Psillos 2001, 2006, Busch 2003, Morganti 2004).

[21] 'The non-token-relative present', which corresponds to the edge of reality within GBT, must crucially be distinguished from 'the token-relative present', which is an indexical like 'here' or 'this place'. Classically, non-presentist A-theories of time recognize both kinds of present, whereas presentism identifies them. As for the B-theory, it recognizes only 'the token-reflexive present', since it typically defines the present as a matter of

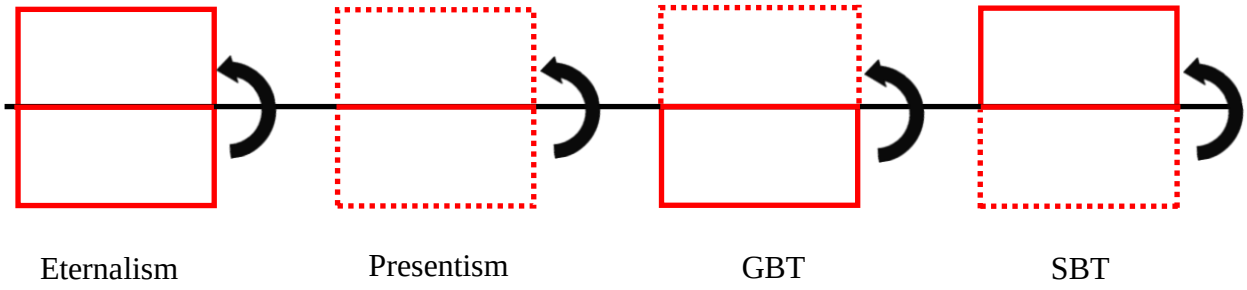
is known as a transformation that preserves all geometric features. Such a transformation can, for instance, be operated on spatiotemporal structures, understood as primitive systems of fundamental spatiotemporal relations and derivative spacetime points. Interestingly, when reflection symmetry is operated around 'the present' axis of a spatiotemporal structure, the outcome is either an unchanged (or invariant) structure (when it is described by eternalism or presentism), or a transformed structure (when it is described by GBT or SBT). The reason is roughly that, unlike eternalism and presentism, GBT and SBT do not take what lies below (or above, respectively) 'the present' axis (viz. spatiotemporally related points) to be a structural reflection of what lies above (or below) it (cf. *Figure 2*).

Therefore, whereas the structures described by eternalism and presentism do not change upon undergoing a reflection symmetry around 'the present' axis, those described by GBT and SBT do change: by 'symmetrizing' the growing block structure one obtains the shrinking block structure, and by 'symmetrizing' the shrinking block structure, one obtains the growing block structure. It thus seems that a simple operation, such as reflection symmetry, when applied around 'the present' axis on spatiotemporal structures, allows one to distinguish between two groups of A-theories of time: the *symmetric* theories (e.g., eternalism, presentism) and the *asymmetric* theories (e.g., GBT, SBT). As a first approach, an A-theory is called 'symmetric' if, when reflection symmetry is applied through 'the present' axis on the spatiotemporal structure it describes, we are left with an unchanged (or invariant) structure. Conversely, a theory is called 'asymmetric' if, when reflection symmetry is applied through 'the present' axis on the spatiotemporal structure it describes, we are left with a transformed structure.[22]

perspective. The question as to whether it is always epistemically possible for non-presentist A-theories of time to distinguish between the two kinds of 'present' has given rise to intense debate (cf. Bourne 2002, Braddon-Mitchell 2004, Forrest 2004, Merricks 2006, Correia & Rosenkranz 2018, Grandjean manuscript).

[22] The question as to whether the notion of present, which requires an absolute relation of objective simultaneity, is meaningful within contemporary physics will not be pursued in this paper. One can only say that, although Relativity seems to rule out absolute simultaneity, quantum mechanics might restore it through instantaneous connections between correlated particles (cf. Bell's theorem) and through the collapse of the wave-packet (cf. Maudlin 2019).

Figure 2



However, it might be objected that there are versions of eternalism for which reflection symmetry around 'the present' axis fails to deliver an invariant structure: (a) if time has a beginning but no end (or vice versa), and (b) if time has both a beginning and an end, but the present is not equidistant from them. For instance, take any time *t* in version (a), reflection symmetry around *t* does change the structure; it delivers a structure where time has no beginning but an end (or vice versa). Of course, it could be replied that this is no big deal, since the opposition between symmetric and asymmetric theories is only meant to carry out a first sorting: symmetric theories include classical forms of presentism and eternalism, whereas asymmetric theories include classical forms of GBT and SBT. In that sense, this opposition does not rule out the possibility of developing non-classical forms of eternalism, which do not satisfy the geometric criterion, provided that they can subsequently be distinguished from both GBT and SBT. That is fair enough, but a better reply would be to define symmetric and asymmetric theories admitting no exceptions. In this regard, appealing to a modal characterization of these theories[23] could be salutary: a symmetric theory is a theory such that possibly always the structures it describes is reflection invariant; conversely, an asymmetric theory is a theory such that necessarily sometimes the structure it describes is not reflection invariant. The qualification 'sometimes' is there because (i) in a given world at the first moment of time (if there is one) the structure described by GBT is reflection invariant, and (ii) in a given world at the last moment of time (if there is one) the structure described by SBT is reflection invariant. Given this modal characterization, non-classical forms of eternalism (a) and (b) also fall under the scope of 'symmetric theories'. By convention, 'eternalism' will refer to eternalism *tout court* (i.e. classical or not) in the remainder of the text.[24]

[23] This idea was suggested to me by Fabrice Correia.

[24] It might be objected that 'the non-token-relative present' cannot be defined as the axis of symmetry for GBT, because some exotic growing models of the universe potentially admit several axes of symmetry. The following two examples were suggested to me by one of my reviewers. First, one might think of the universe as collapsing to a small region from which it expands outwards as in the Big Bang theory, but entropy runs in reverse in the

Since spatiotemporal structures have no more fundamental features than geometric ones (these features are theoretically posited, after all), *asymmetric* theories (e.g., GBT, SBT) are naturally seen as better suited than *symmetric* ones (e.g., eternalism, presentism) to account for (at least some) intuitive differences between the future and the past (cf. Grandjean 2021). Whereas *asymmetric* theories provide, through the geometric features of the structures they outline, an immediate, fundamental and relevant reason as to *why* the future intuitively differs from the past, proponents of the *symmetric* theories must provide further explanations, presumably involving local phenomena (e.g., entropy, irreversibility), to account for the same intuition. Of course, this does not mean that if one accepts an *asymmetric* theory of time, one has to invoke geometric features to explain one or another intuitive past-future time difference. As Ross Cameron (2015: 194) makes clear, a growing blocker can perfectly claim that the geometric structure she describes plays no role in the way time is commonly intuited. But, it seems that the most natural move for her is to take widespread intuitions of *how* the future may differ from the past as manifestations of the intrinsic time-asymmetry of her model.

However, it might be objected that this use of geometry is analyzable in ontological terms and, therefore, that the revisited picture does not genuinely differ from the traditional one. For instance, it might be claimed that to say that the past geometrically differs from the future is only a sophisticated way to say that the past exists, while the future does not. This would clearly be problematic, since the main reason *why* the traditional picture was abandoned is that one has no strong intuitions on whether the future or the past exists. As a reminder, there is no experiential way to differentiate between the past and the future being equally real and not being equally real. However, there are (at least) three reasons to think that this objection does not apply here. First, one can agree on the asymmetric nature of time, while disagreeing on what exists. For example, growing and shrinking blockers agree that necessarily sometimes the future geometrically differs from the past, while they always disagree about what exists

region before the collapse. This might be described by metaphysicians as a block that grows on two fronts, namely our present and the present of our counterparts in what we describe as contracting universe. A second example is based in a similar way on the Gold model of the Universe with entropy reversing in the distant future. In that case the growing block occupies two regions, one up to now and one that is, in our description, in the distant future. However, although these models are interesting, it is not clear that they should count as growing block models. For, the notion of ontological growth, which is essential to GBT, cannot be captured by the increase of entropy, or by the expansion of the universe. Ontological growth is neither a thermodynamical nor a cosmological phenomenon, but involves the coming-into-existence of new things (e.g., moments of time, events) in the present. Physical models that are more likely interpreted as growing models of the universe are CSG models as described, for instance, in Sorkin (2002, 2006), Earman (2008), Wüthrich & Callender (2016), and Dowker (2020). Interestingly, Earman (2008) and Wüthrich & Callender (2016) argue that these models are compatible with a universe-wide border of becoming, which could therefore serve as a single axis of symmetry.

(either both the present and the past, or both the present and the future).[25] Secondly, it clearly appears that a theory such as 'forward-branching time' makes a geometric distinction between the future and the past (the future is branching, the past is singular), while this theory rests on an eternalist ontology (where both the future and the past exist). Finally, although it should be acknowledged that reflection symmetry on spatiotemporal structures can hardly be operated without involving individuals (e.g., spacetime points, events and objects), this does not imply that these individuals should be taken as ontologically primitive. As explained above, individuals play a *heuristic* role allowing for the description of geometric structures, which is not indicative of any ontological priority. It therefore seems that the main difference between the *symmetric* and *asymmetric* A-theories of time is not ontological, but structural (or geometric).

One immediate consequence of the revisited picture is that GBT is no longer to be seen as an ill-conceived hybrid. As a reminder, GBT is traditionally depicted as an intermediate between the polar opposites of eternalism and presentism, with the consequence that this theory accumulates the flaws that are identified in the two traditional models (cf. Sider 2001: 12, Miller 2013: 347). But, since eternalism and presentism are no longer to be defined in terms of whether the future and the past exist (because nothing in actual intuition answers to this question), GBT is not a *mere* mixture of eternalism and presentism (which by itself does not guarantee that GBT escapes the objections that are usually formulated against eternalism and presentism). In the revisited picture, what is essential to GBT is to be *asymmetric*, i.e. to say that necessarily sometimes the structure it describes is not reflection invariant. GBT is thus distinct *by nature* from eternalism and presentism. Another consequence is that eternalism and presentism are no longer to be seen as polar opposites, but rather as similar theories: to the question 'Is there a geometric asymmetry between the future and the past?', they both possibly never answer 'yes'. Surprisingly, this leads to a conclusion close to that of the skeptics, who deny that there is a genuine dispute between eternalists and presentists (cf. Crisp 2004, Ludlow 2004, Meyer 2005, 2011, Sider 2006, Miller 2013). But, whereas the skeptics generally justify their claim by invoking the two interpretations of the universal quantifier 'everything' (tenseless or tensed), the suggestion here is to say that eternalism and presentism are similar with respect to some relevant geometric features.

In the McTaggartian picture revisited, the answer ('possibly never', or 'necessarily sometimes') provided to the question 'Is there a geometric asymmetry between the future and

[25] However, it must be acknowledged that growing and shrinking blockers always agree that either the future or the past does not exist.

the past?' should therefore be considered essential component of the classical A-theories of time. However, this is obviously not sufficient. First, as Maudlin (2007: 109-110) makes clear, space could contain some sort of asymmetry, but that alone would not justify, for instance, the claim that 'Space is open'. The openness of the future underwrites claims such as 'Anything can happen' or 'History is not written beforehand', while a generic spatial asymmetry would not underwrite such locutions. Secondly, although the geometric component provides a clear distinction between *symmetric* and *asymmetric* theories, it does not allow to distinguish between the various forms these theories may adopt. For example, it does not allow to distinguish between eternalism and presentism (which are both *symmetric* theories), nor between GBT and SBT (which are both *asymmetric* theories). Therefore, in order to get a complete categorization of the various A-theoretical views, another component, which does not concern the geometry but the evolution of the model, should be considered essential: the answer ('yes' or 'no') that A-theories provide to the question 'Is temporal becoming (i.e. the creation of new things in the present) real?'.[26] This second component allows one to distinguish between two new groups of A-theories of time: the pure becoming-views (e.g., presentism, GBT)[27] and the non-generative-views (e.g., SBT and eternalism).

Although the question 'Is temporal becoming real?' is of an ontological nature, it can be pre-theoretically evaluated, because, unlike the question 'Do the future and the past exist?', it concerns existence *in the present* that we therefore experience – by contrast, existence in the future and the past cannot be experienced. Thus, not only do we experience a difference between the future and the past, but we also experience that what is occurring (e.g., moments of times, events, etc.) has just been created – this is the idea that *Temporal Becoming* is intended to unpack. According to Henri Bergson, for example, when we are intuiting time we are *primarily* intuiting novelty and creation: "[…] we understand, we feel, that reality is a perpetual growth, a creation without end. […] Every human work in which there is invention, every voluntary act in which there is freedom, every movement of an organism that manifests spontaneity, brings something new into the world" (1944: 261). Formally, *Temporal Becoming* can be expressed as follows: $\mathbf{S}(\exists x\, \mathrm{H}\neg\exists y\, y{=}x)$, where H is the operator 'always in the past'; this formula literally means: 'sometimes, some things have never existed in the past'. This seems justified by the fact that we do experience things as moving from non-

[26] In comparison with, for instance, W.L. Craig's conception (2001: 44), the present conception of temporal becoming is restrictive: it only implies the creation of new things in the present, but not the annihilation of some other things. Moreover, following Broad (1923), Reichenbach (1956), Prior (1970) and many others, temporal becoming is conceived as a *mind-independent* phenomenon; this will be justified in the next section.
[27] This label comes from Curtis & Robson (2016: 67).

existence to existence and, although this is compatible with the exotic phenomenon of intermittent existence, the most plausible assumption is that those things have never existed in the past. It is worth noting that 'to create' is a non-transitive verb (as opposed to other verbs, such as 'to avoid' or 'to prevent', which are properly transitive in the sense that they link two noun-phrases to signify some relation between real objects). In that sense, a creation is not an action upon what is created, since what is created (e.g., an event) is not there until the productive process is finished (cf. Geach 1973: 209). That explains *why Temporal Becoming*, which implies creation, is not available to eternalism and SBT: if always, everything has always existed (**A**($\neg\exists x$ P$\neg\exists y\ y{=}x$)), where P is the 'past-tense operator' (read as 'it was the case that'), then nothing can be created. I thus suggest that the following A-theories should be identified with the conjunction of the two logically independent[28] answers they provide to both of these new questions – one concerning the geometry, the other the evolution of the temporal structure – as follows:[29]

Eternalism: possibly always the temporal structure of the world is reflection invariant (symmetric theory) & there is nothing such as temporal becoming (non-generative-view)
Presentism: possibly always the temporal structure of the world is reflection invariant (symmetric theory) & new things are created in the present (pure becoming-view)
SBT: necessarily sometimes the temporal structure of the world is not reflection invariant (asymmetric theory) & there is nothing such as temporal becoming (non-generative-view)
GBT: necessarily sometimes the temporal structure of the world is not reflection invariant (asymmetric theory) & new things are created in the present (pure becoming-view).

Classifying the above theories this way carries number of advantages. First, it provides an illuminating and comprehensive categorization of the A-theories of time. Secondly, whereas it makes presentism, SBT and GBT inconsistent with the classical B-theory *by definition* (geometric asymmetries and temporal becoming are both *incompatible* with the B-theory), it allows for two kinds of eternalism: *A-theoretical* (the moving spotlight) and *B-theoretical* (B-eternalism). Thirdly, it draws on our intuitions by putting the focus on two questions whose

[28] The fact that the geometric and the dynamic component are logically independent allows, for instance, for the possibility of 'frozen-block presentism', according to which the present is not changing (cf. Price 2011: 279). However, there is an ongoing debate about whether such 'frozen' A-theories of time are coherent (cf. Correia & Rosenkranz 2020).
[29] The idea of defining A-theories in terms of coming into existence and, as we shall see later, of ceasing to exist, has its origin in Deasy (2017). It is worth noting that appealing to temporal ontology here does not make the geometric classification superfluous, since the latter refers to a different (but fundamental) aspect of the spatiotemporal models: their structure (as opposed to their evolution).

specific answers can be confirmed (or refuted) through non-stipulative methods. Finally, it reveals the metaphysical singularity of GBT: this theory is not *essentially* a hybrid between two polar opposite views (eternalism and presentism),[30] but is an alternative to two symmetric models that mainly differs with respect to whether they accept (or not) *Temporal Becoming*. Thus, there are good reasons to abandon the traditional way of introducing the A-theories of time in favor of the new claims formulated above. Specifically, whereas the traditional definitions rely on a question – 'Do the future and the past exist? – that calls for speculative answers, the new claims rely on two questions that can straightforwardly be evaluated by means of intuitions: 'Is there a geometric asymmetry between the future and the past?' and 'Is temporal becoming real?'. A-theories should therefore be seen as the combinations of two components: one *geometric*, the other *dynamic*.

Figure 3

	Geometric future-past asymmetry	**Temporal becoming**
Eternalism	Possibly never	No
Presentism	Possibly never	Yes
SBT	Necessarily sometimes	No
GBT	Necessarily sometimes	Yes

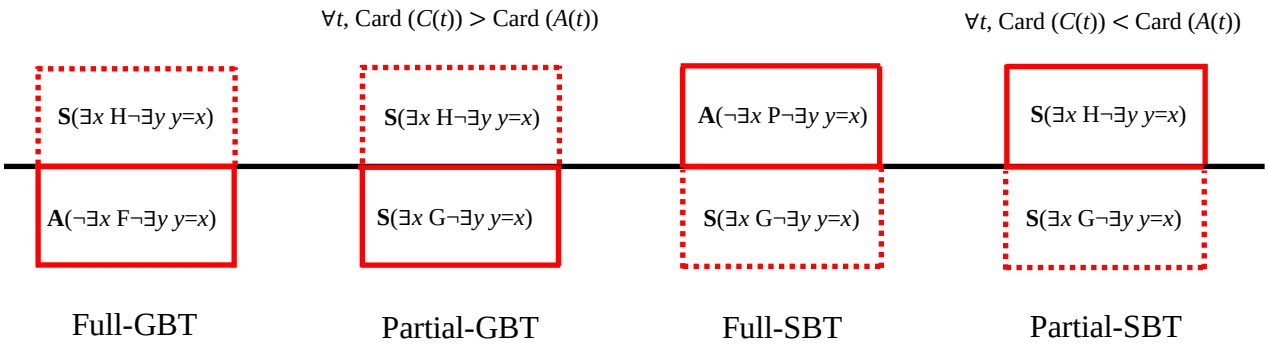
The situation may nonetheless turn out to be more complex than this for at least three reasons. First, one might argue that the two features above – relevant geometric time-asymmetry and *Temporal Becoming* – do not single out GBT. For example, these two features are compatible with the view that 'sometimes, some things go out of existence', which betrays C. D. Broad's original claim that "[t]here is no such thing as ceasing to exist; what has become exists henceforth for ever" (1923: 69). A suggestion would therefore be to regard a further component as essential to GBT: the rejection of *Annihilation*. Formally, this can be expressed as follows: $\mathbf{A}(\neg\exists x\, \mathrm{F}\neg\exists y\, y{=}x)$, where F is the operator 'sometimes in the future'. This formula literally means that always, everything will always exist in the future and, therefore, prevents the block's erosion. This suggestion is appealing, provided that one wants to strictly respect Broad's intentions. But, one might want to adopt a more liberal stance and allow for other sorts of theories, e.g., 'Partial-GBT' (as opposed to Full-GBT), according to which *Temporal*

[30] To be sure, the claim that 'GBT is an ontological hybrid between eternalism and presentism' is not false, but it grasps nothing that is true *in virtue of the nature* of GBT (which is primarily an asymmetric theory that accepts *Temporal Becoming*), cf. Ingram & Tallant 2018: §1.

Becoming holds whereas sometimes, some things will never exist in the future: **S**($\exists x$ H$\neg\exists y$ $y=x$) & **S**($\exists x$ G$\neg\exists y$ $y=x$), where G is the operator 'always in the future'. It indeed seems that such a theory may, under certain conditions (which are not guaranteed by the two principles above), deserve the label 'GBT', since it may also depict a growth in ontology. Intuitively, for all times *t*, if there are *more* things created than things annihilated up to *t*, then we get a growing block model at *t*. Formally, considering the finite set $C(t)$ of created things up to *t*, and the finite set $A(t)$ of annihilated things up to *t*, it seems that the partial theory deserves the label 'GBT' iff, for all *t*, the cardinality of $C(t)$ is *greater* than the cardinality of $A(t)$. Conversely, if (and only if) the cardinality of $C(t)$ is *less* than the cardinality of $A(t)$, then the partial theory seems to deserve the label 'SBT'.

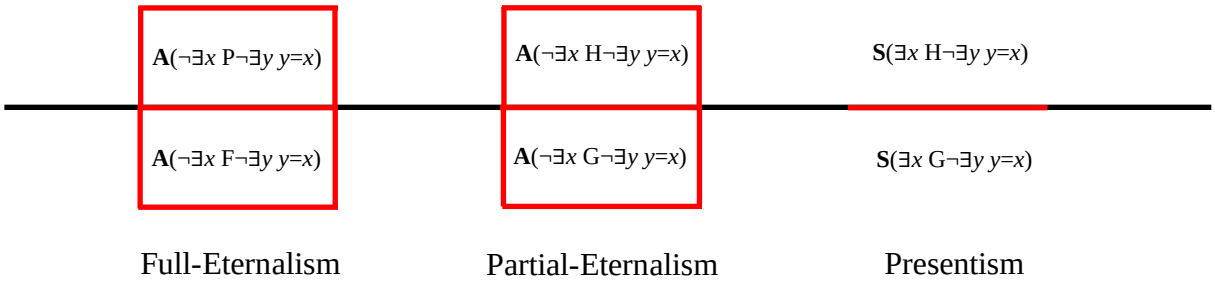
Admittedly, some philosophers might regard Partial-GBT and Partial-SBT with suspicion, insofar as (i) nothing guarantees that the set $C(t)$ is finite, and (ii) the expressions 'growing' and 'shrinking' have a quite different meaning in full and partial theories, so that the labels 'GBT' and 'SBT' assigned to the latter might seem usurped. After all, if $C(t)$ is finite, then given that time is dense, the times are not among the things that are created as time goes by. For comparison, suppose one focuses on the spatial size of things and claims that the view that the size of things constantly grows as time goes by is a version of GBT, it clearly seems that one's claim would be wrong. In reply, although one should acknowledge that Partial-GBT goes against many versions of GBT, such as Correia and Rosenkranz's version, it does not go against all versions of GBT. For instance, a growing blocker who says that growth concerns only the occupants of time (e.g., events, people, objects, etc.) would have no *a priori* reason to dismiss Partial-GBT. Of course, one could then question the motivation behind Partial-GBT, since GBT originally rests on the inexorable increase in the ontology of times to explain, for example, the passage of time. However, our question is not whether this view is motivated, but whether it is consistent.

Figure 4



Concerning the symmetric theories, some of them also seem to allow for at least two interpretations, one full and the other partial. In this respect, 'Partial-eternalism' corresponds to the rejection of both *Temporal Becoming* and *Annihilation*: $\mathbf{A}(\neg\exists x\, \mathrm{H}\neg\exists y\ y{=}x)$ & $\mathbf{A}(\neg\exists x\, \mathrm{G}\neg\exists y\ y{=}x)$. This form of eternalism is called 'partial', because it is compatible with intermittent existence: e.g., a thing exists for one second, then ceases to exist for one second, then comes back into existence for another second, and so on from all eternity. The full form of eternalism corresponds to the conjunction of the two following principles: $\mathbf{A}(\neg\exists x\, \mathrm{P}\neg\exists y\ y{=}x)$ & $\mathbf{A}(\neg\exists x\, \mathrm{F}\neg\exists y\ y{=}x)$. It is worth noting that Full-eternalism entails *permanentism*, i.e. the view that 'always, everything always exists': $\mathbf{A}\forall x\ \mathbf{A}\exists y\ y{=}x$ (cf. Williamson 2013: 4). By contrast, presentism intuitively comes in only one flavor: $\mathbf{S}(\exists x\, \mathrm{H}\neg\exists y\ y{=}x)$ & $\mathbf{S}(\exists x\, \mathrm{G}\neg\exists y\ y{=}x)$. For example, a presentist will typically claim that every living human being never existed before his birth and will never exist after his death. To sum up, if one thinks of C. D. Broad's version of GBT, Full-GBT, as the only palatable version of the theory, then one has to count the rejection of *Annihilation* among the essential components of GBT (with the difficulty of making it pretheoretically evaluable). But, if one wants to be more liberal and allow for partial theories, especially Partial-GBT, then the rejection of *Annihilation* must not be regarded as essential component.

Figure 5



A second reason *why* the situation may turn out to be more complex that what the revisited McTaggartian picture suggests is that it seems possible to reconcile an eternalist view with a time-asymmetry. For instance, Maudlin's view of time is explicitly eternalist – "I believe that the past is real […]. I similarly believe that there is (i.e. will be) a single future" (2007: 108-109) – while it admits an irreducible intrinsic time-asymmetry – "I believe that it is a fundamental, irreducible fact about the spatiotemporal structure of the world that time passes" (2007: 107). This suggests that there is room for a midway position between the reductionist accounts of the asymmetry (e.g., those of Boltzmann 2003, and Reichenbach 1956, which

involve the increase of entropy) and the above 'geometric' account. Huw Price also points in this direction when he confesses that: "[l]ike Maudlin, I am a fan of Earman's Heresy […]. I think that Earman is right to reject reductionism […]; but wrong to the extent that he believes that the answer might lie somewhere else" (2011: 286). To that claim, the most plausible reply is that, although Maudlin argues for an intrinsic and irreducible orientation of the universe, his view should not count among the *asymmetric* theories, at least as defined above. After all, Maudlin (2007: 108) explicitly denies that the time-orientation, as he conceives it, has anything to do with the geometric structure of spacetime (though it is not clear, at least to me, what intrinsic structures of spacetime, according to his account, actually yield such orientation).[31]

Finally, a third reason that could lead to skepticism towards the revisited McTaggartian picture concerns very specific theories of time, such as 'Democritean' presentism and Williamson's necessitism. In short, the new categorization could be criticized for not being fine enough to reveal the metaphysical specificity of these theories. For example, Ross Cameron (2016: 112-114) describes a 'Democritean' version of presentism, according to which always, all there are are eternally existing fundamental particles. This theory, Cameron argues, is a combination of presentism and permanentism which, therefore, seems to transcend the opposition between Full-eternalism and presentism as described above. Another example is Williamson's necessitism, according to which everything exists eternally but things are temporarily concrete. The latter theory is geometrically symmetric and permanentist (and so 'fully-eternalist' according to the classification scheme), but very different to the kinds of views that people usually call 'eternalist'. In reply, two things can be said. First, the new categorization is not meant to exhaust all conceivable sub-variants of the four main A-theories of time, but only to offer an intuitive framework within which these four generic theories can be expressed. Therefore, the revisited McTaggartian picture does not exclude the possibility that, for example, specific forms of permanentism, such as Williamson's necessitism, can be obtained by means of additional criteria. Secondly, it is not clear that 'Democritean' presentism should count as an A-theory of time and, therefore, that it could be held up as a counterexample to the new categorization. After all, this theory does not allow for change (or time passage), which seems to be a minimum requirement to qualify as an A-theory.

In a nutshell, this paper proposed to reconceptualize the classical A-theories of time in terms that make ineliminable reference to the geometric structures in which individuals (e.g.,

[31] Some other philosophers share the same concern about Maudlin's account, see for instance Price (2011: 281-283) and Bartels & Wohlfarth (2014: 490-491).

spacetime points, events and objects) participate, by using theoretical claims that can subsequently be confirmed (or refuted) by experience. These claims allowed one to distinguish between the *symmetric* and the *asymmetric* A-theories of time. Then, the various forms these theories may adopt were identified thanks to two principles – *Temporal Becoming* and *Annihilation* – in charge of the evolution of the models. The revisited McTaggartian picture showed many advantages, including the power of generating 'partial' versions of eternalism, GBT and SBT. Another advantage is that the revisited picture changed our perception of GBT, which is no longer seen as a hybrid between eternalism and presentism, but as a theory in its own right.

5. Conclusion

A-theories of time are traditionally introduced as various answers that can be provided to the question 'Do the future and the past exist?'. However, this traditional way of introducing the A-theories of time is unsatisfying since, from an ontological point of view, there is no pre-theoretical reason to adopt one theory rather than another. After all, the only events we experience are the ones occurring at the time of our experience, whether this be in eternalist or in presentist settings. Moreover, traditional definitions of the A-theories of time cannot be taken as *essential* to them, since there are some specific times (e.g., the Big Bang, the last moment of time) at which they fail to distinguish between the theories in question.

Therefore, a proposal in this paper was to make a fresh start in the debate by introducing the A-theories in terms of a new question: 'Is there a geometric asymmetry between the future and the past?'. The notion of 'geometry' refers here to basic, intrinsic properties of the spatiotemporal structures described by the A-theories. These structures are to be thought as ontologically prior to the individuals (e.g., spacetime points, events and objects) that participate within them (structuralism). In short, A-theories that possibly always answer 'no' to the above question are called '*symmetric*' (e.g., eternalism, presentism), whereas A-theories that necessarily sometimes answer 'yes' are called 'asymmetric' (e.g., GBT, SBT). One consequence of this proposal is that GBT is no longer to be seen as an ill-conceived hybrid between two polar opposites (eternalism and presentism), but as a real alternative to two *symmetric* theories.

However, the question 'Is there a geometric asymmetry between the future and the past?' was shown *insufficient* to distinguish between the various forms the *symmetric* and *asymmetric* theories may adopt. Therefore, in order to get a complete categorization of the various A-theories of time, a second question was introduced: 'Is temporal becoming (i.e. the

creation of new things in the present) real?'. This second question allows one to distinguish between *pure becoming-views* (e.g., presentism, GBT) and *non-generative-views* (e.g., SBT, eternalism). In the McTaggartian picture revisited, GBT is thus singled out as the only *asymmetric* A-theory of time that accepts *Temporal Becoming*: **S**($\exists x$ H$\neg\exists y$ y=x). Assuming that intuitive past-future time differences are best explained by the spatiotemporal structure of the world (*Time Direction Heresy*), this puts GBT in a better position than its rivals to account for some of our intuitions about the nature of time.[32]

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