Exdurantist Growing Block Theory

Abstract: In this paper, I argue that four-dimensionalists have strong motivation to accept the growing block theory (GBT) of time, as in doing so they have an attractive account of change: that for an object to change is for it to accumulate new, qualitatively distinct temporal parts. However, in accepting GBT, the four-dimensionalist ought to be an exdurantist (i.e. a stage theorist) about persistence. I argue that perdurantist GBT is untenable because it will often lead to it being the case that it is 'ontically vague' as to how many continuants there are, which goes against how the perdurantist deals with certain puzzle cases of coincidence and persistence. I conclude, then, that those who accept GBT and four-dimensionalism should be exdurantists, as in holding that continuants are stages and not 'worms' they always give a determinate answer as to how many continuants there are if GBT is true.

Keywords: growing block theory; persistence; exdurantism; ontic vagueness; four-dimensionalism

According to the growing block theory (GBT) of time, past and present entities exist, but future ones do not. Reality consists of a continuously 'growing' block, where the sum of total what exists increases as the block grows. Things 'come into being' at the edge of the block, which is the present. And as the block grows, things in the present become part of the past. GBT then shares features with both presentism and eternalism. Like presentism, GBT holds that there is an objective present, and what is present *changes*; like eternalism, it holds that past entities – once past - never change and will always remain in being.[1] Given the asymmetry of its ontology, GBT seems to have a satisfying account of the – alleged - fixity of the past and openness of the future: the past is fixed because past entities exist, while the future is open because future entities do not.

I take four-dimensionalism to be thesis that objects possess temporal parts at every sub-interval of the interval of time they exist. Some object, x, is a temporal part of an object, y, at some interval of time t just in case that (i) x is part of y; (ii) x exists only during t; and (iii) x overlaps

[1] GBT was initially introduced by C.D. Broad (1923), while its contemporary defenders include Tooley (1997), Forrest (2004), Diekemper (2005), Briggs and Forbes (2012), and Correia and Rosenkranz (2013).

every part of *y* that exists at *t*.[2] According to four-dimensionalists, objects persist by either possessing multiple temporal parts or standing in *temporal counterpart relations* to other temporal parts.[3]

In this paper, I'm going to argue that there is strong motivation for four dimensionalists to embrace the growing block theory of time. For in accepting GBT, the four dimensionalist will have an appealing account of change, in which an object can 'genuinely' change as it persists through time, in a more substantial way than merely having qualitatively different temporal parts at different times. That is, I propose that on four-dimensionalist GBT, change will involve the *accumulation of new temporal parts* as the block grows. However, I will then go onto show that four dimensionalist GBT is only plausible if one is an exdurantist – i.e. stage theorist - about persistence: that continuants are instantaneous stages, which are temporally counterpart related to stages at earlier/later times. To show this, the paper will be structured as follows. In the first section, I will initially show that those who accept GBT ought to accept the 'open future' is metaphysically possible, after which I will argue that four dimensionalists who accept GBT have a very appealing account of change. In the second section, I then argue against perdurantist GBT, as it would often turn out to be *ontically vague* – if the future is open - as to how many continuants there are; a commitment, which I argue, is untenable for the perdurantist. In the third and final section, though, I show that if exdurantist GBT is true one can always give a determinate answer to the question of how many continuants there are, given that exdurantists hold continuants are stages and not worms. I conclude, then, that not only do four-dimensionalists have strong motivation to embrace GBT, in doing so they should be exdurantists about persistence.

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[2] I take this definition of a temporal part from Sider (2001, 60), but formulate it to be neutral about whether said temporal part is instantaneous or not.

[3] Josh Parsons (2000) has argued, however, that one can be a four-dimensionalist yet not accept that ordinary continuants have temporal parts. If he is correct, references to four-dimensionalism in this paper should be taken to only refer to 'temporal parts' four-dimensionalism.

1. Four-dimensionalist Growing Block Theory

1.1. Growing Block Theory and the Open Future

Before I go onto assess four-dimensionalist growing block theory, it is first necessary to examine the connection between GBT and the open future. For as we shall see in section two, the case against perdurantist GBT rests crucially on there being worlds in which it is indeterminate at the 'present' time, as to what will happen to a presently existing object in the future. Following work by Barnes and Cameron (2011), as well as Briggs and Forbes (2012), I understand the future as being open if and only if there are *at least some* propositions about the future which are *not yet determinately true or false*. That is, the future is open because it is presently *unsettled* as to what it will be. Some might think the future being indeterminate is due to it being ontically vague as to whether future entities exist,[4] but if one accepts GBT this lack of determinacy will simply be due to the absence of future entities in our ontology. That future entities do not exist yet is the reason as to why there are propositions about them which are not determinately true or false, yet. Accepting GBT does not then, in itself, entail *any entities* indeterminately exist.

Typically, GBT theorists accept that – it is at least metaphysically possible – the future is open[5], but it is possible that one could accept GBT while rejecting the open future. As Ross Cameron (2015, 194) notes, "The growing blocker is not even forced into saying the future is open in any sense whatsoever: she could, for example, that while there is no future ontology, there are brute facts about what will happen." This may be so, but what I think can be shown is that such a version of GBT would be so unappealing, nobody tempted by GBT would accept it. To begin with, the fact GBT that provides us with a satisfying account of the – alleged – fixity of the past and openness of the future, has been taken to be an important desiderata in its favour. For in

[4] This is the case on Cameron's (2015) moving spotlight theory: future entities exist, but it is indeterminate as to *which* future entities exist.
[5] For instance, Diekemper (2005), as well as Briggs and Forbes (2012).

accepting the existence of entities in the past, but rejecting future ones, the GBT theorist has an informative explanation for the apparent metaphysical difference between the past and future.

But even if giving an account of the open future were not desirable for the growing blocker, it can be shown that the open future is something they ought to be committed to anyway. For, if we suppose there are metaphysically possible indeterministic worlds, a proponent of GBT should accept, what I call, the 'Indeterministic to Indeterminate' (II) principle:

(II): $\exists w \neg((E \wedge L) \supset (\Delta[p] \vee \Delta\neg[p])) \supset \nabla[p]$

Suppose w is some world where the block has grown to some extent, and let [p] stand for some arbitrary proposition about something in the future. Let 'E' be the plurality of all entities that 'presently' exist, and 'L' be the laws of nature of that world. 'Δ' an operator which expresses that some proposition is determinately true, and '∇' an operator which expresses that some proposition is indeterminate. What (II) then states is that there is some world w, such that if the entities in the block and the laws of nature do not entail that some proposition is determinately true or false, then that proposition is indeterminate. Basically, if there are indeterministic possible worlds and future entities do not exist in them, then at least in some of those worlds there will be propositions about the future which are not determinately true or false.

(II) seems a plausible principle if GBT is true. If future entities do not exist, then it seems we need some kind of 'ontological ground' in what exists in the block for determinate future truths. For instance, given our knowledge of the Moon's orbit, we can ascertain that there will be a total solar eclipse in Antarctica on the 4th December 2021. Even though this future event has yet to have happened, given that both 'E' and 'L' seem to entail that it will happen, we have good grounds for supposing the proposition there'll be an eclipse in Antarctica on December 4th 2021 is determinately true. By contrast, 'Boris Johnson will win the next UK general election' does not seem to be determinately true, as – supposing determinism is false – the presently existing entities and laws of nature will not necessitate whether Johnson wins or not. It seems completely

possible that Johnson might well lose the next general election, or resign before the next general election, or there be some other event which prevents him from winning. *Prima facie*, if GBT is true and the world is indeterministic, Boris winning the next general election is neither determinately yet true or false.

Not only is (II) plausible at face value, denying (II) would also undermine how GBT theorists typically account for truths about past entities. For unlike the presentist, growing blockers can appeal to the past entities themselves as truthmakers for propositions about them. For instance, it will be true that Caesar crossed the Rubicon 49 BC because this past event still exists according to the growing blocker: it's just no longer present. If the GBT theorist rejects (II), though, they will have no choice, as they cannot appeal to any future entities, but to either hold that there are propositions about the future which are either brute truths or are made true by abstract 'ersatz' times (Crisp 2007), the world instantiating some primitive (future) tensed properties (Bigelow 1996), or some other account of truthmakers for temporal truths which presentists often appeal to. But if there are primitively true future propositions or the growing blocker avails themselves to 'presentist friendly' truthmaking accounts for past/future temporal truths, the proponent of GBT will have no advantage over the presentist in respect to truthmaking. For if we do not need truthmakers for future truths, or give truthmakers for them which are compatible with presentism, then there seems to be no reason as to why either past truths require truthmakers or why a presentist friendly account of truthmakers for past truths is implausible.

What this shows is that while it is not incoherent for the growing blocker to deny (II), the resultant version of GBT will not likely be a version of it anyone tempted by GBT will accept. Not only does denying (II) mean the GBT theorist would have to give up two of the most prominent arguments for view (i.e. accounting for the open future and truthmaking), but (II) itself seems plausibly true if GBT is true: if the laws and presently existing entities do not entail some proposition about the future is determinately true or false, it is not determinately true or

false *simpliciter*. There is good reason, then, to suppose any plausible version of GBT will be one in which it is metaphysically possible the future is open.

1.2. An argument for four-dimensionalist GBT

I'm now going to present an argument in favour of four-dimensionalist GBT, and why it should be preferred to an eternalist version of four-dimensionalism. The argument is that GBT four-dimensionalists have an appealing an account of change, in which – like their eternalist cohorts – their account of change enables them to give a satisfying solution to the problem of temporary intrinsics, but – unlike their eternalist cohorts - this account of change allows an object to change its properties in a more substantial way change than merely having qualitatively different temporal parts. For many opponents of four-dimensionalism reject it because they hold that there is more to an object changing its properties than this. An object changing its properties across time is *different* from how we would describe spatial variation; me being five-feet tall as a boy and then six-feet tall as a man, is different from a poker being hot at one end and cold at another. Of course, many four-dimensionalists (such as Sider (2001, 212-216)) just to try to meet this objection head on and claim change across time *is analogous* to spatial variation, but I think we can do better. By accepting GBT, a four-dimensionalist can hold that objects change in a more substantial way than how there can be spatial variation in an object. Change doesn't just involve an object having a variation of temporal parts, but involves the *accumulation of new qualitatively different temporal parts*.

There are two distinct varieties of four-dimensionalism: perdurantism (worm theory) and exdurantism (stage theory). Perdurantism is the thesis that objects persist by being a trans-temporal fusion of all their temporal parts/stages. Exdurantism, on the other hand, is the thesis that 'ordinary' objects are instantaneous stages which 'persist' through time by being temporally counterpart related to some other earlier/later stages. To see why the GBT four-dimensionalist

account of change is appealing, let us examine what change will involve for both perdurantism and exdurantism if GBT is the correct view of time.

If I am a perdurantist, to say I was once five-feet tall is to hold that I have a temporal part which is five-feet tall in the past, and to say that *I am* six-feet tall is to hold that I have a temporal part which is six-feet tall in the present. Both the eternalist perdurantist and the GBT perdurantist can agree on this. But what the perdurantist growing blocker *can also say* is that 'I was five-feet tall' is a tensed truth of the world, because the temporal part of me which is five-feet tall *was once present*, and at that point in the block's history I did not have any temporal part which is six-feet tall. But now that I do have such a temporal part, in the present, it is now a tensed truth of the world that *I am six-feet tall*. I have changed because I have gained 'new' temporal parts which are qualitatively different than those which already exist in the block, and 'I am six-feet tall' is true *simpliciter* because the temporal part of me which *is present at the block's edge* is six-feet tall.

If I am a exdurantist, to say that I was once five-feet tall is to hold that I am some instantaneous stage which bears a temporal counterpart relation to some instantaneous stage in the past which is five-feet tall, and to say that *I am* six-feet tall is to hold that the stage I am *is six-feet tall*. Both the eternalist exdurantist and GBT exdurantist can agree on this. But, *again*, what the exdurantist growing blocker *can also say* is that is that 'I was five-feet tall' is a tensed truth of the world, because the stage that I am is temporally counterpart related to a stage which is five-feet tall *which was once present*. And it is now a tensed truth of the world that I am six-feet tall, *simpliciter*, because the stage I am is six-feet tall and *is present*. I have changed because the five-foot stage I am temporally counterpart related to is no longer present, but the stage I am now is, and that stage is qualitatively different from that earlier stage. What change then is for the exdurantist growing blocker is that some stage ceases to be present, and becomes temporally counterpart related to a qualitatively distinct stage which is.

I am not the first person to suggest conjoining four-dimensionalism with the A-theory. Berit Brogaard (2000) has previously defended a presentist version of perdurantism, in which objects persist by having some presently existing temporal part, but has/will have other temporal parts at other times. The fact what temporal part of the object exists constantly changes, will account for how objects change. But as Benovsky (2009) has argued, it does not seem plausible that an object could be an *aggregate* of its temporal parts if the aggregate never exists either at a time or 'atemporally'. If some material object, *y*, is an aggregate of some *xs*, then it surely seems for *y* to exist then the *xs* would need to exist. However, as previously present entities continue to exist according to GBT, four-dimensionalist GBT avoids this problem, and thus has an attractive solution to the no change objection, while – like eternalist four-dimensionalist – also managing to provide a solution to the problem of temporary intrinsics. In fact, in embracing GBT, the perdurantist's solution to that problem becomes more plausible, as it isn't just true that some temporal part of me is six-feet tall, *simpliciter*, per eternalist perdurantism (Lewis 2002, 5); but, as we saw above, we can actually say that I am six-foot tall *simpliciter* because the *temporal part of me which is present is six-feet tall*. And it is this, the perdurantist growing blocker can say, is what makes it true that I possess some monadic property *simpliciter*.

It is clear that by embracing the GBT, the four-dimensionalist would have an appealing account of change, which is more substantial than merely having qualitatively different temporal parts. Both perdurantists and exdurantists who accept GBT can hold change involves the accumulation of new temporal parts, and that material objects can have their monadic properties *simpliciter* by them having – or being identical to – some present temporal part.[6] There is strong motivation, then, for four-dimensionalists of both stripes to accept GBT. But is GBT compatible with either

[6] Of course, as Sider (2000) has argued, an eternalist stage theorist has the means to account for the intuition that we have our monadic properties *simpliciter*, given that ordinary continuants will be instantaneous stages whether we accept eternalism or GBT, and thus will have their monadic properties, *simpliciter*. So, there's no advantage for the exdurantist accepting GBT in this particular respect. But given the exdurantist GBT has a better account of change, I hold that it's still preferable to its eternalist cohort.

type of four-dimensionalist? I'm going to argue that the answer will be no, if one is a perdurantist, but yes, if one is an exdurantist. Subsequently, there is thus then strong motivation for not only a four-dimensionalist to embrace GBT, but in doing so they should accept *exdurantist growing block theory*.

2. Perdurantist Growing Block Theory

So let us now turn to my case against perdurantist GBT. Perdurantists think we can give a determinate answer as to how many continuants there are in puzzle cases of coincidence and persistence. But in accepting GBT, it will turn out that perdurantists will often not be able to give a determinate answer as to how many continuants there are. It will be *ontically vague* as to how many continuants there are.

To see this, let us first consider the case of the statue and the lump. Suppose that a statue – Goliath – and the lump of clay that constitutes it – Lumpl – are brought into existence at the same time. According to the perdurantist, whether Lumpl and Goliath are identical or are distinct objects will ultimately depend on whether they share all the same temporal parts or not. If Goliath is smashed and Lumpl is rearranged to constitute a new statue, then the two will not be identical as Lumpl has temporal parts which are lacked by Goliath. But suppose that Goliath and Lumpl are both annihilated by a ray gun, and thus go out of existence at the same time. Then as Goliath and Lumpl will have all the same temporal parts as each other, the perdurantist will identify the two as being the same object. The perdurantist then will be able to provide a metaphysically determinate answer to the question, "how many objects are here?", and this answer will depend on whether Lumpl and Goliath share all the same temporal parts.[7]

[7] If Lumpl and Goliath are identical, how does the perdurantist account for seeming *de re* modal truths such as 'Lumpl *could* have survived being smashed, but Goliath *couldn't*'. To solve this, perdurantists generally appeal to counterpart theory. Even though Lumpl and Goliath are the same object, this object can stand in different counterpart relations to distinct objects. 'Lumpl could have survived being smashed, but Goliath couldn't', is true in-virtue of Lumpl/Goliath standing in counterpart relations to lump counterparts which have survived being smashed, and standing in counterpart relations to statue counterparts which go out of existence upon being smashed (see Lewis (1971) and Sider (2001, 113)).

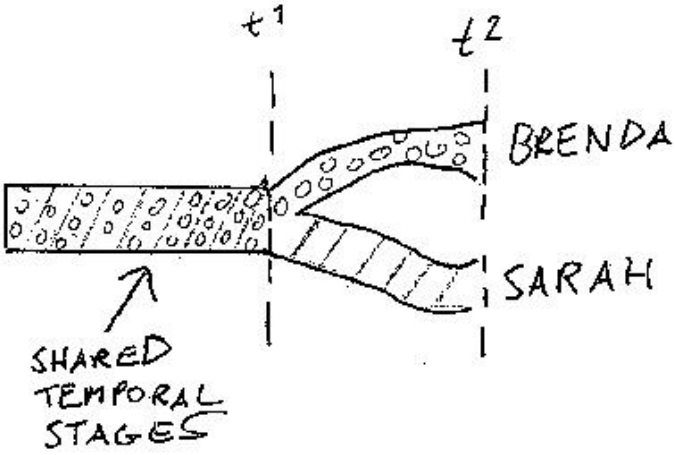
But if GBT is true, the perdurantist will often not be able to give a determinate answer to this question. For suppose Lumpl and Goliath were created together at some past time, and both still remain existence at the present time. Then whether Lumpl and Goliath are distinct or identical will depend on the occurrence of some future event. This future event could be Goliath being smashed – which Lumpl survives – or both Lumpl or Goliath being destroyed by a ray gun, and so on. Regardless, whether Lumpl or Goliath being the same object or distinct will depend on an event which is not existent – according to GBT – and thus it will be *metaphysically indeterminate* as to whether there are two objects or one, given that it will be *metaphysically indeterminate as to whether Lumpl and Goliath have the same temporal parts*. Contra to what we initially supposed, the perdurantist would not be able to provide a determinate answer to this puzzle case.

There is worse yet to come, though, for the perdurantist growing blocker, for let us now consider another puzzle case of persistence: fission. Typically, perdurantists think they can preserve the idea that identity is what is of prudential concern for the 'person' who undergoes fission, and do so by holding that two or more distinct persons can share a temporal part. To see this, suppose that Anissa is captured by an insane surgeon, who at *t1* removes the two hemispheres of her brain, and at *t2* successfully manages to implant them into new bodies. Let us call the resulting successor persons, 'Brenda' and 'Sarah', and let us imagine they are both psychologically continuous with Anissa. They have the memories, beliefs, and desires she did prior to the surgery. Are both Sarah and Brenda then identical to Anissa? Given that they are psychologically and physically continuous with Anissa – let us say they stand in the *R-relation* to her – we might well think so. But if they are, presuming the transitivity of identity, can this be so given that Sarah and Brenda are not identical to one another? It might, then, be that identity is not what is of prudential concern to Anissa, but rather the preservation of the R-relation; which normally coincides with identity, but is distinct from it. But denying the importance of personal identity is counterintuitive. Surely, *Anissa* would be the one who would want to survive the

operation? Why should she care about happens to two distinct persons in the future? What she cares about is whether *she* survives.

The perdurantist, however, thinks they can solve this problem. Look at the figure below:

Fig. One: Fission on a 'Eternalist' Perdurantism



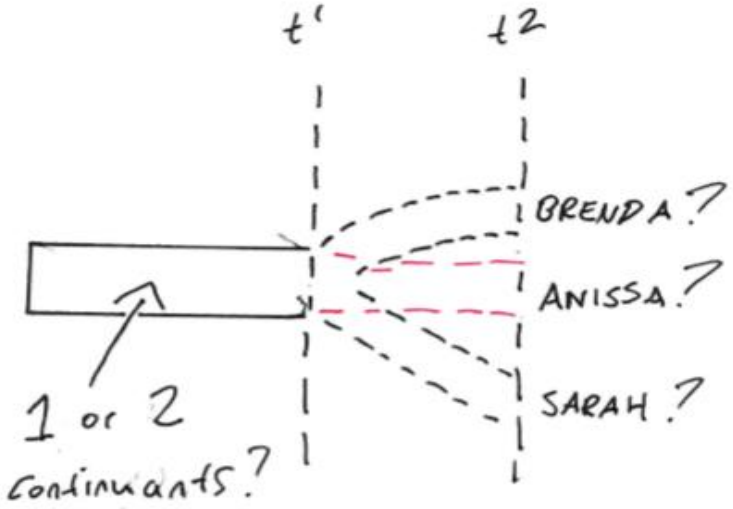
Prior to the operation at *t1*, Brenda and Sarah 'share' their temporal parts. Any temporal part of Brenda prior to *t1* is also a temporal part of Sarah, and vice versa. The mistake we made, the perdurantist insists, is that we supposed that Brenda and Sarah did not exist prior to completion of the operation at *t2*, and that there was only one person prior to *t1*. We incorrectly supposed that one person – Anissa – became two people, when in reality there were *always two people all along*. According to David Lewis (1983, 60), persons are *maximal R-interrelated aggregates of person stages*. As the stages which we thought composed Anissa are not a maximal R-interrelated aggregate – given that 'Anissa' is a temporal part of both Sarah and Brenda – there never was a single person to begin with prior to the operation. Instead, there had always been two, which just happened to initially share their temporal stages. The stages which existed prior to *t1* are R-related to stages at *t2*, and both sets of stages are temporal parts of some continuant person, hence some person at *t1* will be identical to a later person at *t2*. Thus, identity *does matter* to a person[8] undergoing fission. Therefore, not only can the perdurantist give a determinate answer

[8] Or to be more precise, *persons*.

to the question, "how many people existed before and after the operation?" – the answer being two – but this answer does not force us to conclude identity is either intransitive or not of prudential concern to someone undergoing fission.

But what if the perdurantist accepts the growing block theory of time? Let us imagine that *t1* is the present moment, and the surgeon is just about to begin the operation. He is, however, having potential second thoughts about whether to go through with the operation, and is considering just letting Anissa go. If we assume the world they are in is indeterministic, there will be no fact of the matter yet as to whether the operation occurs. What does this mean, then, for Anissa, Sarah, and Brenda? Consider the figure below:

Fig. Two: Fission on a 'Growing Block' Perdurantism



Because when *t1* is present it is unclear whether the temporal stages belong to a single person or two, it is *metaphysically indeterminate* as to whether there are one or two persons prior to the operation. It is not yet determinate as to whether the temporal stages prior to *t1* belong to two distinct but overlapping persons – which depends on the operation going ahead – or if they only belong to only one. In accepting GBT, the perdurantist then would not be able to give us a determinate answer "how many people existed before the operation?" until after the operation is complete at *t2*. But this just looks bizarre. True, Lewis (1983, 65) does say that it will be ambiguous prior to the fission as to whether – in thinking we were referring to a single person –

we are referring to a person or a temporal part of two distinct persons; but this will be an *epistemic* ambiguity, not a metaphysical one. Surely there are a determinate number of people which exist prior to the operation, and why should the number of people prior to the operation be determined by a future event – the operation – which *does not even exist*?

My concern here is not necessarily scepticism about whether there can be ontic vagueness in the world. Rather, it is that much of the appeal behind the perdurantist solution to fission cases was that they could provide a *determinate metaphysical answer* as to how many continuants there were. It is an important desiderata of any solution to fission cases that it should always be able to tell us how many people exist prior to the fission.[9] If they accept the existence of future entities, the perdurantist is always capable of telling us how many there are, but this is not so if – given GBT – they reject the existence of future entities. Furthermore, the GBT perdurantist now seems to have a theory of personal identity which is in conflict with the notion that the existence or non-existence of an object should not be dependent on the *non-existence* of a future event/object. By accepting future entities, the (eternalist) perdurantist avoids this problem by holding it was always determinately the case Anissa did or did not exist. But if – per GBT - it's indeterminate at *t1* as to whether she exists, then whether she *currently exists* will depend on the existence of some future entities extrinsic to her: Brenda and Sarah. And this just looks bizarre. How can whether a person currently exists depend on some future objects, extrinsic to them?[10,11]

[9] The idea then is that the perdurantist ought to accept what Harold Noonan (2003, 105) calls the 'Determinacy Thesis': that it is always a determinate matter as to how many continuants there at some instant of time, and whether these individuals are identical to any earlier/later continuants.

[10] The motivation of this objection is also that which motivates the *only x and y principle*: that *x* being identical to *y* should not be dependent on anything *extrinsic* to them. See Noonan (2003, 127-143) for a more in depth discussion of the principle.

[11] It should also be noted that if GBT perdurantism leads to it being indeterminate as to how many objects there are, the argument from vagueness for four-dimensionalism would be untenable. Perdurantists would not be able to argue in favour of four-dimensionalism on the grounds that there would be either be brute or vague cut off points if objects endure, if in accepting GBT it turned out to be ontically vague as to how many objects perdure.

However, there are a couple of replies the GBT perdurantist could make to my objections against the theory, which I will now consider. And both replies involve the perdurantist growing blocker trying to argue that there is determinately *at least one* continuant prior to the fission.

2.1. Reply 1 – Persons can be 'temporal parts' of other persons

The first reply the GBT perdurantist could make would be to reject Lewis' idea that persons are maximal R-interrelated aggregates of person stages. If so, a person could be a temporal part of another person, and thus a perdurantist could recognise the existence of Anissa prior to the operation. The perdurantist could then hold that there is determinately one person – Anissa - prior to the operation, but it is ontically vague as to whether Brenda and Sarah also exist. Whether Anissa is a temporal part of these two persons, however, will be resolved by whether the surgeon performs the operation.

This is not much of an improvement. To begin with, it is still the case the perdurantist will not be able to provide us with, when *t1* is present, a determinate answer to the question "how many people exist?" prior to *t1*. Now, the perdurantist could say things have improved because they can say *there is a determinate person prior to t1*, and that perhaps this explains our intuition there is a determinate answer to the question considered above. Still, I find this disconcerting. Much of the appeal behind the perdurantist solution was that it could give us a determinate account of what happened in fission cases, and in putting forward this reply they would be giving up on that. It also fails to address the concern that the existence of how many/what ordinary objects there are now should not depend on some non-existent future event or entities. For the reason as to why it is indeterminate that Brenda and Sarah exist is because it's indeterminate whether the surgeon will perform the operation. Whether they currently exist then depends on the existence of some future entities which are extrinsic to them: Anissa's possible *post-t1* stages.

In fact, it may turn out that if Anissa survives her encounter with the surgeon, then her own existence depends on the non-existence of either Brenda or Sarah. For suppose the operation

goes ahead, but rather than transplanting both of her hemispheres in distinct bodies, he destroys one of them and transplants the other into the body belonging to Brenda. Does Anissa survive the operation? Given that there is only a single person after the operation who claims to be her, and is both psychologically and physically continuous with her, it seems like we should say yes. Anissa then would be the same perduring entity as Brenda: the perduring entity when *t1* was present would be identical to the perduring entity when *t2* is present. If so, the *only x and y principle*[12] would be violated, as Anissa being identical to Brenda depends on the non-existence of Sarah. But how can the existence of an entity extrinsic to both Anissa and Sarah, affect whether they are identical? Therefore, I do not think that dropping the idea that persons are maximal R-interrelated person aggregates means the GBT perdurantist's account of fission will be plausible.

It should also be noted that this line of response would also not be of much use in dealing with the case of Lumpl and Goliath, as it will be ontically vague as to whether they are the same object or are distinct. A perdurantist dropping the notion that persons are maximal R-interrelated aggregates of person stages, will obviously still be able to do nothing to abet this problem. In light of this and the problems outlined above, I do not think a perdurantist abandoning the idea that persons cannot be temporal parts of other persons will rescue perdurantist GBT.

2.2. Reply 2 – How many continuants there are at a time can change as the block grows

The second reply the GBT perdurantist could make would be to hold that the number of continuants there are at a time can change as the block grows. That is, the growth of the block can literally bring about a change in what is true of the past. Imagine then when *t1* is present, Lumpl and Goliath come into being. As Lumpl and Goliath share all the same temporal parts, the GBT perdurantist will identify the two as the same object. But suppose at *t2* Goliath is

[12] As stated in footnote 10, the only *x* and *y* principle states that if *x*=*y* then their identity should not be dependent on any entity extrinsic to them.

smashed and Lumpl is rearranged to constitute a new statue. According to the GBT perdurantist, Lumpl and Goliath should now be recognised as having been distinct objects all along, and it is now true of the past time *t1* that there are two continuants – and not one – where earlier in the block's history there was one. As for fission, the perdurantist growing blocker can also provide with us a similar story there. When *t1* is present, there is a single continuant Anissa, as she is not a proper part of any other person(s). However, when *t2* becomes present and the fission occurs, the GBT perdurantist will now state there have been *two continuants all along*, as the person stage at *t1* – Anissa – is a proper part of two persons: Brenda and Sarah. It is now true of *t1* there were two continuants there, even though earlier in the block's history there was only one. The lesson, then, the perdurantist will say we should take from this is that if GBT is true past truths about how many continuants there were can change.

If this is the cure for perdurantist GBT, then I suspect it is worse than the illness. How can smashing a statue or performing a surgical operation on someone change the past? It seems somewhat incredible to believe that a contingent action I can perform in the future can change what is true of a past time in the block. Past entities and events in the block can be more no more affected by things in the present than I can causally influence things which are outside my light cone. The past has been and gone, and events in it cannot be altered once they have 'played out'.[13] However, it might be able that the perdurantist growing blocker can provide us some independent motivation for thinking that what is true of past times can change as the block grows. For one, it seems that how far certain objects and events are away from the edge of the block is something that is always changing. When the 24th January 1965 was present, the event of Winston Churchill's death was present at the edge of the block. But now that 2019 is the year

[13] The only exception to this might be if time travel is metaphysically possible. Van Inwagen (2010), for instance, has developed a GBT model of time travel involving hyper-time: a higher-order dimension of time which contains ordinary time. On this model, time travellers can change the past without paradox, because when they travel back into and change the past, hyper-time continues to progress. This is quite different to the GBT perdurantist reply considered, however, as performing a fission or destroying a statue are not events which involve *any entity travelling back in time*. Perhaps, we can alter past times on the block by sending tachyons back in time or entering a time machine, but the same does not seem to be true of an everyday action such as destroying a statue.

present at the block's edge, his death is now fifty-four years 'away from the edge of the block'. How far Churchill's death is away from the block is fact about a past time which is constantly changing.

I do not think such a change, however, is analogous to a change in how many continuants there are at a time. For how far the time at which Churchill's death occurred is from the edge of the block is an *extrinsic* fact about that time about the time his death is located. How far a time is away from the present is a fact which supervenes on something which may be distinct to that particular time. The time at which Churchill's death occurred was once present, but it is an obvious consequence of GBT that as the block grows that time will cease to be present, and thus how far away from the present will continuously change. This does not seem true of continuants at a time. 'There are *n* continuants' appears to be an intrinsic property of a time. If there are two continuants at some spatial region at *t1* when it is present, then there will be two continuants at that region when *t1* ceases to be present. How many continuants there are, *prima facie*, does not seem to depend on how much the block has grown. 'There are *n* continuants' is plausibly an intrinsic property of a time, and in order to alter it one would one have to perform a contingent action located at some future time. That there can be extrinsic changes to past times in GBT does not, then, give us any motivation to think there can be *intrinsic* changes to past times in GBT.[14] So, I think this reply should also be rejected.

3. Exdurantist Growing Block Theory

In this section, I'm going to argue that even if GBT is true, exdurantism's treatment of coincidence cases will be unaffected. We saw in the previous section that perdurantists would no

[14] It should be noted, that the Dead Past version of GBT initially formulated by Forrest (2004), and then later developed by Forbes, gives us no reason to think there can be such intrinsic changes either. According to Forrest and Forbes, organisms located in the block's past are no longer alive and lack consciousness. They *were* alive and conscious when times they exist at were present, but now no longer are. Bus as Forbes himself acknowledges, being alive is an extrinsic property in Dead Past GBT, as its possession requires its bearer to be in the block's present. If the bearer ceases to be present, they will cease to have the property.

longer be able to give determinate answers to the puzzle cases of coincidence and persistence, if future events and entities do not exist. The GBT exdurantist, though, can give the same account of what goes on these puzzle cases as if they were eternalists, given that they believe ordinary continuants are *stages* and not worms.

Firstly, let's consider the case of Lumpl and Goliath. According to the exdurantist, given that ordinary continuants are stages, there is a single object here which is both Lumpl and Goliath. If the matter it is constituted out of ceases to constitute a statue in the future, then it will be temporally counterpart related to a lump of clay which is not a statue (Sider 1996, 441-445; 2001, 200). If GBT is true, the core of the exdurantists' account remains intact: there is a single continuant where Lumpl and Goliath are, and that continuant will be temporally counterpart related to an object which is both a statue and a lump, or is just a lump. The only difference is, that the Lumpl/Goliath stage will only become temporally counterpart related to the future lump stage when that stage 'comes into being' at the edge of the block. And this stage, for instance, will have the property of 'once being a lump' because it is lump counterpart related to the Lumpl/Goliath, while Lumpl/Goliath will gain the property of 'continuing to exist as a lump in the future' in-virtue-of now being lump counterpart related to the future lump stage. Unlike the GBT perdurantist, the GBT exdurantist is still capable of providing a determinate metaphysical answer to this puzzle despite rejecting the existence of future entities.

Now let's turn to fission. How many persons exist at *t1* according to the eternalist exdurantist? The answer will be one, as there is only a single person stage at *t1*. If the operation occurs, then this person stage will be person counterpart related to two future continuants – Brenda and Sarah – and if it doesn't, she'll only be person counterpart related to one. And these future continuants will have the property of 'existing at/prior to *t1*' in-virtue of being person counterpart related to the past stage at *t1* (Sider 1996; 2001, 188-208). How many persons exist at *t1* according to the GBT exdurantist? Again, the answer will be only one, as there is still only

one person stage at *t1*. And this stage *will be* person counterpart related to two future continuants if the operation occurs, but if it doesn't will only be person counterpart related to one future continuant. The only difference being – like the case of Lumpl and Goliath – the person stage at *t1* will only become temporally counterpart related to the future person stage/stages when they 'come into being' at the edge of the block. But this future stage will, for instance, still have the property of 'once existing at/prior to *t1*' in-virtue-of being person counterpart related to the stage at *t1*. And conversely, if the operation occurs, the stage at *t1* will have the property of 'surviving as Brenda' and the property of 'surviving as Sarah', in-virtue-of being person counterpart related to these two future stages. Unlike the perdurantist, then, it is clear the exdurantist is capable of providing a metaphysically determinate answer to the question of "how many people existed prior to the fission?" at *t1*.

I imagine that someone might object to exdurantist GBT by arguing that it has the same problem as the GBT perdurantist's Reply 2: it involves changes occurring to past times on the block. For as we've seen, upon the fission occurring, the person stage, Anissa, will become temporal counterpart related to two future continuants, which it was not counterpart related to when *t1* was present. So, there has been a change to a past time in the block. However, this change will be an *extrinsic* change and not an intrinsic change, as none of Anissa's intrinsic properties are changed by Brenda and Sarah coming into being. Anissa becoming temporally counterpart related to Brenda and Sarah is an extrinsic change, and extrinsic changes are common and innocuous in GBT. If we think changes in how far a time is away from the edge of the block are innocuous, then changes in whether something is temporally counterpart related to a future continuant should also be considered innocuous. Therefore, I conclude that exdurantism and GBT are compatible, and so – given the failure of perdurantist GBT – a four-dimensionalist growing block theorist ought to be an exdurantist.

4. Conclusion

In this paper, I initially argued four-dimensionalists should accept GBT over eternalism, as this would enable them to have an attractive account of change, which will involve the *accumulation of new temporal parts*. But, as we have seen, GBT and four-dimensionalism are compatible only if one is willing to be an exdurantist. For in accepting perdurantism and GBT results in the perdurantist often being unable to give a determinate answer to the question of how many continuants there are at time. Exdurantism's account of how many continuants there at a time, though, is not undermined by them accepting GBT, given exdurantists hold that continuants are stages and not worms. Therefore, not only is there strong reason for four-dimensionalists to accept the growing block theory of the time, but in doing so they ought to be exdurantists.

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