Dialetheism and the A-Theory

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Abstract

According to dialetheism, there are some true contradictions. According to the A-theory, the passage of time is a mind-independent feature of reality. On some A-theories, the passage of time involves the movement of the present. I show that by appealing to dialetheism one can explain why the present moves. I then argue that A-theorists should adopt this explanation. To do this, I defend two claims. First, that the dialetheic explanation is an improvement on the only other explanation available for why the present moves and, second, that adopting the explanation is better than leaving the motion of the present unexplained. Assuming that A-theorists should adopt the best available version of their view, it follows that they should adopt a dialetheic explanation of why time passes.

Keywords: Dialetheism, Time, Contradiction, Passage, A-theory.

1. Introduction

According to the A-theory, temporal passage is a real, mind-independent phenomenon. On some A-theories, temporal passage involves the movement of the present.[1] Such moving-present A-theories (henceforth just A-theories) face a suite of questions: why does the present move? Why does it move into the future? Why does it move at a constant rate and at what rate? Without answers to these questions, it's difficult to rule it certain possibilties. One possibility is that the present is frozen in time and never moves. Another possibility is that the present moves but towards the past. A third is that the present speeds up, slows down, or stops. A fourth is that the present jumps, skipping over times. Not being able to rule out these possibilities is a problem for A-theorists, since the present is supposed to move, of necessity, toward the future with a constant rate and without jumping.

A-theorists have two options. First, they can take it as a brute fact that the present moves in a certain way. Second, they can seek to explain why the present moves by answering the above questions. The first option is common among A-theorists. The second option, by contrast, is under-theorised. Indeed, there's only one such explanation available—devised by Skow (2012). However, this explanation implies that the physical state of the universe is always changing, which conflicts with physical models of our universe.

*Forthcoming in *Philosophical Quarterly*. Email: s.baron@unimelb.edu.au

[1] Tallant (2015) defends an A-theory without a moving present. Some defend a B-theory with passage (see Deng (2013); Leininger (2021); Oaklander (2015); Deasy (2018); Pooley (2013) for discussion). My arguments don't apply to these views.

My goal is thus to offer a new explanation for why the present moves. I then argue for two claims. First, that the explanation is an improvement on Skow's and, second, that adopting the explanation is better than leaving the motion of the present unexplained. Since, currently, the only options are to endorse Skow's explanation, leave the motion of the present unexplained, or adopt the explanation presented here, it follows that my explanation is the best available option for developing the A-theory. On the plausible assumption that the A-theorist should adopt the best available version of their view, it follows that they should adopt my explanation of why time passes.

A notable feature of my explanation is that it uses dialetheia—true contradictions. Accordingly, the best way to be an A-theorist is to be a dialetheist. This is interesting for A-theorists but also for dialetheists, since it presents a new path toward dialetheism. In this way, the arguments here hold significance beyond the philosophy of time.[2] To set the scene for those arguments, I will start by outlining Skow's account (§2). My dialetheic account will follow soon after (§3) and then I will compare the two explanations (§4). I finish by arguing that the dialetheic explanation is better than taking the motion of the present as brute (§5).

2. Skow on Passage

Skow uses hypertime to analyse the motion of the present. To say that the present moves is to say that at one hypertime ht, time t is present but that for some hypertime ht′ ≠ ht, t′ ≠ t is present. The present moves on Skow's model because what he calls the 'superstate' of the universe is constantly changing. The *state* of the universe is a 3D spatial configuration of, say, all particles and inter-particle distances at a time. The *superstate* is a description of the state at every time for a particular hypertime. The superstate changes from hypertime to hypertime when there's some change in which states obtain in time at those hypertimes. More carefully, there's a change in the superstate between ht and ht′ only when the physical state at some time shifts from being indefinite at ht (which is its default state) to being definite at ht′. However, the only way for the physical state at a time to become definite is for the present to occupy that time. Thus, change in the superstate can only keep happening if the present keeps occupying new times, transforming them from being indefinite to being in a definite physical configuration. In this way the changing superstate necessitates the motion of the now.

Skow makes this picture precise with a battery of principles (Skow 2012: 227–239). The principles are stated below. Note that 'supertime' in these principles refers to hypertime.

1a For any time t, if there is a point in supertime at which t is NOW, then there is an Earliest point in supertime at which t is NOW.

1b Relative to each point in supertime, the universe is in a definite state at the time that is NOW relative to that point.

[2] Priest (1985; 1992; 2006) also provides a dialetheic account of passage. However, this account does not explain why the present moves and isn't supposed to: it's neutral between the A-theory and the B-theory. Priest's account forms part of a general analysis of motion and change. My account may be applicable at this level, and so may also have significance for this broader debate.

1c Let t be any time. There are two cases:

Case 1: t is not NOW relative to any point in supertime. Then the universe is not in any definite state at t relative to any point in supertime. (That is, there is no fact of the matter about what state the universe is in at t—not even about whether anything exists at t.)

Case 2. t is NOW relative to some point in supertime. Let q be the Earliest point in supertime at which t is NOW, and S the state the universe is in at t relative to q. Then relative to any point in supertime Later than q, the universe is in S at t; relative to any supertime point Earlier than q, the universe is not in any definite state at t.

1d The NOW's motion is continuous.

2a The Necessity of Change (discrete case): At adjacent points in supertime, the universe is in distinct superstates.

2b The Necessity of Change (continuous case): Each possible career in configuration space is a differentiable function that always has non-zero derivative.

3 Call the two directions in time X and Y. If there is any point in supertime p such that the NOW is located at one time relative to p and at a time in direction X relative to its successor p', then there is no point in supertime q at which the NOW is located at one time relative to q and a time in direction Y relative to q'.

4 For any point in supertime p, the rate in supertime at which the universe is changing at p is equal to the rate in time at which the universe is changing at N(p).

From these principles, Skow derives three facts: (i) the present always moves; (ii) the present always moves into the future and away from the past without jumping and (iii) the present moves at a constant rate of one time per hypertime. He shows this for both discrete and continuous time, thereby capturing time in full generality.

Note that Skow does not take his explanation to require the existence of hypertimes, despite hypertime featuring heavily. Rather, he takes hypertime to be a useful fiction that helps to explain why time passes. Fictional devices are used in a great many explanations. Highly idealized explanations within science often make use of false claims. It is thus difficult to indict Skow's approach simply on the basis that it takes hypertime to be a fiction, at least not without indicting the use of idealizations in explanation more generally. To be sure there could be some specific reason why we cannot idealize time in the manner Skow suggests, by taking it to be two-dimensional. But it is unclear what the problem with this might be. Note further that Skow does not initially introduce hypertime for the purposes of explaining why time passes. Rather, hypertime is introduced as a device for making sense of what it is for the present to move—since movement through one dimension generally needs to be specified against a second. It is then used to help explain why the present moves. Providing an account of what it is for the present to move is plausibly something that all A-theorists need to do.

At any rate, I will grant that we can use hypertime in explanation in the manner that Skow suggests. I also won't challenge Skow's explanation, I only wish to highlight five of its important features. First, Skow's model is proposed as an explanation in a specific sense: it is a model which necessitates that the present moves into the future at a constant rate, where the model does not presuppose a moving present. It is explanation in this sense—as necessitation from a specific model of time that does not presuppose the motion of the now—that I will focus on throughout.

Second, Skow's model requires indeterminacy. This is evident in (1c), which states that the universe at a time is in no definite state until the present has reached that time. Moreover, as Skow makes clear, this is a crucial part of the explanation. It is the 'becoming definite' of the universe that helps drive the present forward.

Third, Skow's model makes assumptions about time and passage. It assumes the past is fixed: once a time becomes past and thus definite, it cannot lose this status. This is needed to prevent indeterminacy from reforming (and is encoded in (1c), Case 2). The model also presupposes that future and present times can change. If a time is present it can lose this status, and if a time is future it can shift from being indefinite to being definite. A third presupposition is that times never go from being future, and thus indefinite, to being past, and thus definite, without first being present.

Fourth, principles (2a) and (2b) require that the physical state of the universe always changes. This implies that where there's no change in physical states, time does not pass. Note that a mere change in the location of the present does not qualify as a change in the physical state of the universe. Only a change in the superstate and thus in the physical state of material entities at a time qualifies.

Fifth, Skow's approach requires that hypertime and time are infinite. He makes this clear at one point:

> First note that the NOW has not always been at t. That is, there is a point of supertime q Earlier than p such that $N(q) \neq N(p)$. This follows immediately from (1) and (2). (Skow 2012: 234)

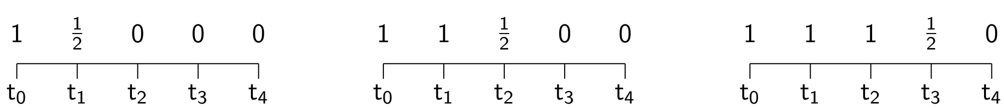
Where (1) and (2) are principles (1a)–(1d) and (2a)–(2b) above, and where N(t) is a function from hypertimes to times that are present. To see that hypertime must be infinite if the above is true, note that Skow takes t to be any time whatsoever. Suppose, then, that hypertime is finite, and that at the first moment of hypertime, ht, t is present at ht. Then it follows that there's no hypertime $ht' < ht$ at which some $t' \neq t$ is present, because there's no earlier hypertime. Thus, the presence of a first moment of hypertime falsifies the claim in the quoted passage. Similar considerations show that time must be infinite as well. For suppose that t is present at a moment of hypertime ht and that t is the first moment of time in hypertime (which is possible if time is finite). If t at ht is the first moment of time in hypertime, then there are no times prior to t at earlier moments of hypertime. But then it follows that there's no hypertime $ht' < ht$ at which some $t' \neq t$ is present, which also contradicts the quoted passage.

3. Passage Dialetheism

I will return to Skow's explanation later. My goal in this section is to offer an alternative explanation for the movement of the present. Here's the basic idea. First, assume a particular conception of the present: that it is where the past and future meet. Take the point at which the past and future meet to be both past and future. Assuming that if something is past then it is not future and vice versa, it follows that the present is inconsistent.[3] Next, assume that the past and future always meet at some time, and so some time is always present. Finally, assume that the universe is governed by a principle of 'contradiction minimisation': whenever a contradiction arising from incompatible temporal properties obtains at a time, it immediately gets stamped out and no such contradiction can arise there again.

These ideas combine to produce a dynamics. To see this, assume that the past and future meet at a time t, which is present. Because t is present, it features incompatible temporal properties which makes it inconsistent. This contradiction is immediately annihilated, and t can no-longer support such a contradiction. But if t can no-longer support such a contradiction, then the past and future cannot meet at that time, since wherever they meet generates a contradiction of the relevant type. But the past and future always meet at some time, and so they must now meet at some new time $t' \neq t$, which becomes present as a result. This generates a contradiction at that new time, t', which must get resolved. This forces the past and future to meet at some third time $t* \neq t' \neq t$ which generates a new contradiction and so on. Thus, we have a 'whack-a-mole' picture of time in which contradictions keep popping up and getting forced down, moving the present with each 'whack'.

We can start to sharpen this idea as follows. First, assume again that contradictions arising from incompatible temporal properties always get settled. Thus, if a time t features such a contradiction, then it will get stamped out, and never again arise at that time. But now suppose that these contradictions are settled in a specific way, by taking times that are both past and future and making them just past. Finally, assume again that there's always a time at which the past and future meet. Putting these assumptions together, we get a picture like the one below.



In this diagram, $1 =$ just past, $\frac{1}{2} =$ past and future and $0 =$ just future. In the first image, the past and future meet at t_1. This generates a contradiction at that time. In the next image, the contradiction has been settled by removing the property of being future from t_1. This makes t_1 just past. Now, we know that t_1 cannot be both past and future again. We also know that the past and future need to meet somewhere, but they cannot meet at t_1. On the plausible assumption that adjacency is necessary for meeting, the past and future can't meet at any time later than t_2, because times later than t_2 are not adjacent to past times and so there's no such time at which the past and future meet. Similarly, the past and future can't meet at t_0 because t_0 is not adjacent to any future times and, again, adjacency is needed for meeting. So the past and future must

[3] Tallant (2015) argues that some account of being past and being future is needed to justify their incompatibility. Here's one: being past is, in part, being closed, in this sense: if a time is past then the material state of that time is settled; whereas being future is, in part, being open: the material state of that time is unsettled. Being settled and being unsettled are incompatible attributes, so the past and future are incompatible. I'm reluctant to adopt this picture here, however, since it presupposes an open future, which alters the dialectic. I thus prefer to leave the incompatibility unjustified. The lack of justification doesn't effect my argument, since the two alternatives to the dialetheic explanation seem to assume the same incompatibility. On both accounts, nothing is ever both past and future and it's unclear what else might explain this.

meet at t_2, which is the only time that is adjacent to both past and future times and so is the only time at which the past and future can meet. But this generates a new contradiction, which is settled in the third image, forcing the present to reform at t_3 and so on.

The model faces four questions. First, why are dialetheia removed? The answer, I propose, is that some dialetheia—those arising from incompatible temporal properties—are *unstable*. While such dialetheia can obtain, they do not do so comfortably. Rather, the features that generate the contradiction compete for dominance: each temporal property entails the non-existence of the other, and so the two properties struggle against each other to be, generating an unstable state. Because physical systems display a global tendency toward stability, the unstable state inevitably collapses.[4] Are all dialetheia unstable? I don't believe so. Instability explanations usually involve temporal features, suggesting that only dialetheia arising from temporal properties are unstable. Can the instability be further explained? Perhaps, but I won't do that here.[5] Instead, I take it to be a basic feature of the model.

Next: times shift from being past and future to being just past, rather than to being just future. Why? Because being past is fixed, whereas being future can change: once something is past, this cannot be undone, but something's being future can be undone, and so the contradiction settles asymmetrically.

Third: when dialetheia are removed they cannot reform. Why? Because *only* future times can change their temporal attributes. A time that lacks the property of being future is unalterable in this sense. Accordingly, when a time is both past and future it can change its temporal attributes. However, once a time is just past it cannot be changed in this way. Since times that are dialetheic become just past as the contradiction resolves, they cannot then change and regain the property of being future to become dialetheic in the same way again.

Fourth: does the dialetheic explanation rule it out that the first moment of time is present? One might think so. If the first moment is present, it is both past and future. But, one might object, the first moment of time cannot be future.

On the contrary, the first moment can be future, for two reasons. First, as Tallant (2015: 539) argues, it is conceivable and thus possible that God creates a world in which 'all of the times bear the property 'future''. Indeed, as Tallant notes, it seems possible for there to be just one time that is future. In both cases, the first moment is future because all moments are. So the first moment can be future.

Second, consider the following principle: if the present moves then, for any time t that is present, t used to be future. This is a compelling constraint: if the principle is false, then the present could move to times that were never future. But, plausibly, the present cannot move in this way. From this principle, however, it follows that if the present moves and if the first moment is present, then it was future. But if the first moment was future, then it can be. So assuming that if time passes then the first moment can be present it can be future, in line with my model. Now, I suppose one could avoid this, by defending a version of the principle that carries an exception for the first moment. However, the

[4]There are many examples of this tendency: the gaps in the rings of Saturn exist because they are regions of orbital instability in which nothing can stay; knives don't balance on their points because thatt's unstable; gasses diffuse into equilibria because that's their stable state; a boulder sits at the bottom of a hill because that's a point of stability.

[5]Something like Zardini's (2019) explanation of instability for contraction might work.

exception would make passage strangely disunified: passage for the first moment would diverge from how it works in general. A better, more unified view of passage commits to the principle as stated.

The dialetheic model can be made yet more precise via the following principles:

(P1a) At every ht, some t is present.

(P1b) Every t at every ht is either past, present or future.

(P2a) If t at ht is past and future, then t is just past at every ht$'$ $>$ ht.

(P2b) If t at ht is just past then t is just past at all ht$'$ $>$ ht.

(P3) If t at ht is past and future then for all t$'$ $>$ t, t$'$ is just future and for all t$'$ $<$ t, t$'$ is just past.

(P4) For any t, if t is just past at ht and just future at ht$'$ then there is an ht$*$ such that ht $<$ ht$*$ $<$ ht$'$ at which t is present.

In these principles, hypertime plays the role of the distinct images in the diagram above. Thus, each image is a moment of hypertime.

A bit about the principles: (P1a) requires that some time is present at every hypertime. Note that for all (P1a) says, it could be the same time for each hypertime. (P1b) prohibits a certain kind of indeterminacy, namely cases in which a time fails to be either past, present or future. Principles (P2a) and (P2b) capture three ideas. First, that contradictions are settled, in this sense: if t is both past and future at a hypertime, then it is only past at every later hypertime. Second, that the past is fixed: if a time is past, then this cannot be undone. Third, only future times can change their temporal attributes. Thus, if a time is just past, then its temporal attributes cannot be altered.

Principle (P3) captures the idea that the present is where the past and future meet in time. Note that the past and future can only meet at one time per hypertime (a second present would violate the principle). (P4), by contrast, captures the plausible idea that a time only changes from being just future to being just past by first being present. This is captured by requiring that the past and future meet in hypertime as well as time. Thus, according to (P4), if a time is just past at one hypertime and just future at another, it is present at a hypertime in between.

These principles necessitate the motion of the present. Note first that from (P1)–(P4), (C1) is provable:

(C1) For any $\mathrm{ht_n}$, if $\mathrm{t_n}$ is present at $\mathrm{ht_n}$ then $\mathrm{t_{n-1}}$ is present at $\mathrm{ht_{n-1}}$ and $\mathrm{t_{n+1}}$ is present at $\mathrm{ht_{n+1}}$.

To prove (C1), let $\mathrm{ht_n}$ be $\mathrm{ht_3}$ and let the $\mathrm{t_n}$ that is present at $\mathrm{ht_n}$ be $\mathrm{t_3}$. Then there are two ht adjacent to $\mathrm{ht_3}$: $\mathrm{ht_2}$ and $\mathrm{ht_4}$. We can then prove (C1) for $\mathrm{ht_3}$ in two stages. First, we can prove that if $\mathrm{t_3}$ is present at $\mathrm{ht_3}$ then $\mathrm{t_4}$ is present at $\mathrm{ht_4}$:

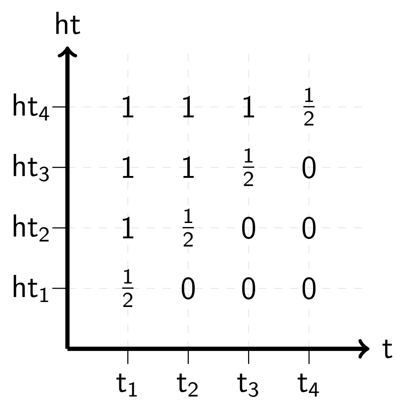
> By (P1) some time t at $\mathrm{ht_4}$ is present. There are three options: $\mathrm{t} = \mathrm{t_4}$, $\mathrm{t} < \mathrm{t_4}$, $\mathrm{t} > \mathrm{t_4}$. Suppose $\mathrm{t} < \mathrm{t_4}$. Then either $\mathrm{t} < \mathrm{t_3}$ or $\mathrm{t} = \mathrm{t_3}$. If $\mathrm{t} < \mathrm{t_3}$, then by (P3) $\mathrm{t_3}$ is just future at $\mathrm{ht_4}$. But by (P2a) $\mathrm{t_3}$ is just past at $\mathrm{ht_4}$ because $\mathrm{t_3}$ is past and future at $\mathrm{ht_3}$. So $\mathrm{t} \not< \mathrm{t_3}$. If $\mathrm{t} = \mathrm{t_3}$ then $\mathrm{t_3}$ is both past and future at $\mathrm{ht_4}$. But by (P2a), $\mathrm{t_3}$ is just past at $\mathrm{ht_4}$ because $\mathrm{t_3}$ is both past and

future at ht_3. So $t \neq t_3$. So $t \not< t_4$. Suppose that $t > t_4$. Then by (P3), t_4 is just past at ht_4. But by (P3) t_4 is just future at ht_3 because t_3 is past and future at ht_3. So by (P4) there must be some ht_n such that $ht_3 < ht_n < ht_4$ at which t_4 is both past and future. But there's no such ht_n. So $t \not> t_4$. So $t = t_4$.□

Next, we prove that if t_3 is present at ht_3 then t_2 is present at ht_2:

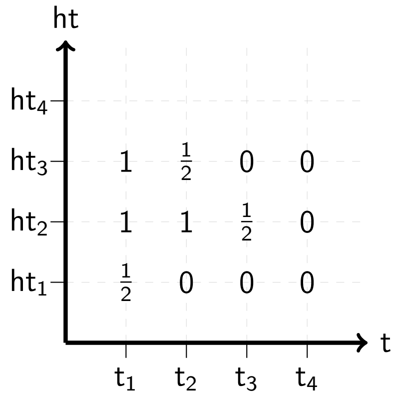
> By (P1) some time t at ht_2 is present. There are three options: $t = t_2$, $t < t_2$, $t > t_2$. Suppose $t < t_2$. Then by (P3), t_2 is just future at ht_2. But by (P3) t_2 is just past at ht_3 because t_3 is both past and future at ht_3. So by (P4) there must be some ht_n such that $ht_2 < ht_n < ht_3$ at which t_2 is both past and future. But there's no such ht_n, so $t \not< t_2$. Suppose $t > t_2$. Then there are two options: either $t = t_3$ or $t > t_3$. Suppose $t = t_3$. Then by (P2a) t_3 at ht_3 is just past. But t_3 at ht_3 is both past and future. So $t \neq t_3$. Suppose $t > t_3$. Then by (P3) t_3 is just past at ht_2 and by (P2b), t_3 is just past at t_3. But t_3 at ht_3 is both past and future. So $t \not> t_3$. So $t = t_2$.□

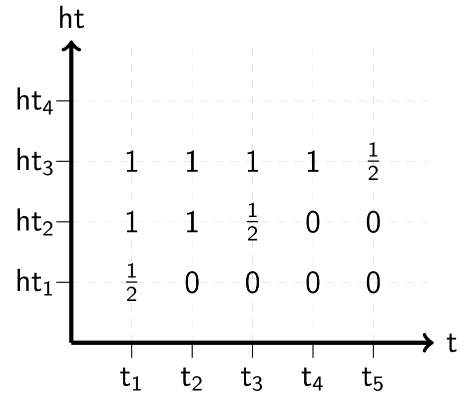
Because the selection of t_3 at ht_3 was arbitrary, the above reasoning generalises, establishing (C1) in full. (C1) handles the case of *discrete* time completely. For note that if (C1) is true, then we get the following picture:



In this picture, the present is always moving away from the past and into the future at a rate of one t per ht. Thus, (P1)—(P4) deliver the same explanatory goods as Skow's model for the case of discrete time. The difference being that the motion of the present issues from the way that contradictions are settled and reformed rather than from changing superstates.

(P1)—(P4) rule out two kinds of cases: (i) cases in which the present moves from t_1 to t_3 and then backwards to t_2 and (ii) cases in which the present jumps from t_1 to t_3 to t_5 (both depicted below).





The case where the present moves backward is on the left. This case violates the condition that only times that are future can change. For in such a case, times change from being just past to being past and future (e.g., t_2 at ht_2 / ht_3 in the diagram). But by (P2b) times that are just past cannot change in this way. Any case of reversal will be similarly ruled out: for any t, if t at ht is present, then by (P3), all $t' < t$ at ht are just past. So for the present to move to a $t' < t$ at $ht' > ht$, some $t' < t$ that's just past must change and become present.

The case where the present jumps is on the right. Take ht_2. By (P3), t_2 at ht_2 is just past because t_3 is present. However, at ht_1, t_2 is just future. By (P4), then, there should be an ht_n such that $ht_1 < ht_n < ht_2$ at which t_2 is present. But there's no such ht. Thus, the situation depicted cannot arise (the same reasoning applies to t_4 at ht_2 / ht_3). In essence, jumps require times to shift from being future to being past without being present, which (P4) rules out.

This brings us to the case of continuous time. First, let a function p take each hypertime to the time that is present at that hypertime. Since, by (P1a), at every hypertime, some time is present, the entirety of hypertime is the domain of the function. We then show that for any hypertimes $ht' > ht$, $p(ht') > p(ht)$:

> Suppose for reductio that there's a pair of hypertimes $ht' > ht$ such that $p(ht') \not> p(ht)$. Let $p(ht') = t'$ and let $p(ht) = t$. Then either $t' < t$ or $t' = t$. Suppose $t' < t$. Then by (P3), t is just future at ht' because at ht', $t > t'$. However, by (P2a), t is just past at ht' because t is both past and future at $ht < ht'$. So $t' \not< t$. Suppose $t' = t$. t' is present and so both past and future at ht'. However, by (P2a) t' is just past at ht', because $t' = t$, t is both past and future at ht and $ht' > ht$. So $t' \neq t$. So there's no pair of hypertimes $ht' > ht$ such that $p(ht') \not> p(ht)$.□

If, for any hypertimes $ht' > ht$, $p(ht') > p(ht)$, it follows that for any pair of distinct hypertimes the present has moved, because it is at distinct times at those hypertimes. We also know that the present will always move into the future, because at later and later hypertimes the present is always located at later and later times.

Next, we introduce (1d) from Skow's model (slightly reworded):

(P5) The movement of the present is continuous.

Given (P5) and given that the present is always moving between any pair of hypertimes, it follows that p—which represents the motion of the present—is a continuous function. We now show that this function has a constant rate of change. From this it follows that the motion of the present never slows down or stops, and thus that the present is in constant motion. This is important since ruling it out that the present slows or stops is part of the explanatory project at hand.

One way forward is to notice that p is a strictly increasing function, where p is a strictly increasing function iff for any hypertimes $ht' > ht$, $p(ht') > p(ht)$, a fact that has already been shown. Strictly increasing functions tend to be characterised by a positive slope, and thus a positive rate of change. Unfortunately, strictly increasing functions can have zero derivatives. For instance $y = x^3$ has a zero derivative, when $y = 0$. However, if we focus only on real values greater than zero, then a strictly increasing function should have only non-zero derivatives. From this it follows that the present never stops, since stopping would require p to have a zero derivative somewhere.

If time and hypertime are infinite, then we can perhaps safely ignore the case of $ht = 0$, since there's no such hypertime. However, we may not want to presuppose that time and hypertime are infinite. So we need to say a bit more here. We also need to say something about the rate at which the present moves. For recall that, on Skow's picture, the present moves at one t per ht, a fact that has not yet been established for the continuous case.

A useful way forward is to adopt a further principle:

(P6) The present moves at the same rate that the past grows.

Note that by the growth of the past, I *don't* mean the growth in the past that characterises the growing block theory. The idea is not that new entities, events or times come into existence. Rather, the idea is simply that the amount of time that is past grows as the present moves, and that the rate of growth and the rate of motion are the same. This is compatible with moving spotlight or presentist views, since even on those views the amount of time that is past changes as the present moves.

How does (P6) get us a constant rate of motion for the present? Well, from (P1)–(P4), (C2) and (C3) are provable:

(C2) At every ht, at least one t is past that was not past at any $ht' < ht$.
(C3) At every ht, at most one t is past that was not past at any $ht' < ht$.

(C2) implies that the past grows at a constant rate of at least one t per ht. (C3) implies that the past grows by at most one t per ht. Together, (C2) and (C3) imply that the past grows at a constant rate of one t per ht. From (P6) we can conclude that the present moves at a constant rate of one t per ht, which is the desired answer. Crucially, it also follows from (C2), (C3) and (P6) that the present never slows or stops. That's because slowing or stopping requires a change in the rate at which the present moves, and there's no such change as the rate is constant.

Here is a proof for (C2):

> First, prove (L1): at each ht, a t is present that was not present at any $ht' < ht$. By (P1), at each ht some t is present. Select an arbitrary ht, ht_1

and an arbitrary t, t_1. Now, suppose for reductio that there's some $ht' < ht_1$ at which t_1 is present. By [P2a] t_1 is just past at all $ht* > ht'$. So t_1 is just past at ht_1. But t_1 is not just past at ht since t_1 is present at ht_1 and so both past and future. So if t_1 is present at ht_1 then there's no $ht' < ht_1$ at which t_1 is present. Since ht_1 and t_1 are arbitrary, the reasoning generalises to all ht.

Next, prove (L2): for any ht, if t is present at ht then t is not past at any $ht' < ht$. By (P1), at each ht some t is present. Select an arbitrary ht, ht_1 and an arbitrary t to be present at ht_1, t_1. Now, suppose, for reductio, that t_1 is past at some $ht' < ht_1$. If t_1 is past at some $ht' < ht_1$ then either t_1 is just past at $ht' < ht_1$ or t_1 is present at $ht' < ht_1$. Suppose t_1 is just past at some $ht' < ht_1$. If t_1 is just past at ht', then by [P2b], t_1 is just past at all $ht* > ht'$. But then it follows that t_1 is just past at ht_1. But t_1 is present at ht_1 and thus not just past at ht_1. So t_1 is not just past at $ht' < ht_1$. Next, suppose t_1 is present at some $ht' < ht_1$. By [P2a] t is just past at all $ht* > ht'$. But then it follows that t_1 is just past at ht_1. But t_1 is present at ht_1 and thus not just past at ht_1. So t_1 is not present at $ht' < ht_1$. So t_1 is not past at some $ht' < ht_1$. Since ht_1 and t_1 are arbitrary, the reasoning generalises to all ht.

(L1) and (L2) imply that at every ht some t is present that was not present at any $ht' < ht$, and that t is not past at any $ht' < ht$ either. Since t is both past and future and thus past, it follows that some t is past that was not past at any $ht' < ht$, which is (C2).□

And here's a proof of (C3):

Suppose, for reductio, that at some ht, there are two times t and t' such that (i) $t' > t$; (ii) t and t' are past; (iii) there's no $ht' < ht$ at which t is past and (iv) there's no $ht' < ht$ at which t' is past. By (P1), some t is present at ht. There are four options: (a) t is present and t' is just past; (b) t is just past and t' is present; (c) both t and t' are present or (d) both t and t' are just past.

Suppose (a). Then by (P3), t is present and t' is just future. But by (ii) assumed for reductio t' is not just future, it is past. So it is not the case that (a).

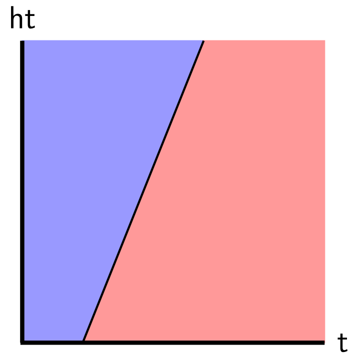
Suppose (b). By (iv) there's no $ht' < ht$ at which t is past. It thus follows that there's no $ht' < ht$ at which t is present. Thus, by (P1b) t must be just future at every $ht' < ht$. But if t is just future at ht' and just past at ht and $ht' < ht$ then by (P4) there's some $ht*$ such that $ht' < ht* < ht$ at which t is present and thus past. But this contradicts (iv), which rules out (b).

Suppose (c). Then by (P3), t' is just future because t is present and $t' > t$. But by (c) t' is not just future. So it is not the case that (c).

Suppose (d). Then by (iii) and (iv), there's no $ht' < ht$ at which t' is past and no $ht' < ht$ at which t is past. So by (P1a) t and t' must be just future at each $ht' < ht$. But if t and t' are just future at each $ht' < ht$, then there's

> some $ht* < ht$ at which t is just future and some $ht+ < ht$ at which t' is just future. But because t and t' are just past at ht then by (P4) there must be some $ht?$ such that $ht* < ht? < ht$ at which t is present and some $ht@$ such that $ht+ < ht@ < ht$ at which t' is present. But then there are ht at which both t and t' are past, which contradicts (iii) and (iv). So it is not the case that (d).
>
> Because (a)–(d) exhaust the cases, reject the assumption made for reductio.□

So far, it's been shown that the present moves at a constant rate. We also know that the present moves into the future, because we have established that for any hypertimes $ht' > ht$, $p(ht') > p(ht)$. But there's a wrinkle. If we map the function p, (C1) and (C2) are compatible with the following picture:



In this picture, the line represents the function from hypertimes to times that are present at those hypertimes; the blue region represents times that are just past, and the red region represents times that are just future. If we imagine extending the line and the shaded regions infinitely, we can see that there will always be times that are either just past or just future that never will be present at any hypertime, because they never fall on the line.

To rule this out, we must establish that every time is present at some hypertime. First, we establish (C4):

> (C4) For any t that is present at ht and any t' that is present at $ht' > ht$ where $t \neq t'$, every $t*$ in the interval $[t, t']$ is present at some hypertime in the interval $[ht, ht']$.

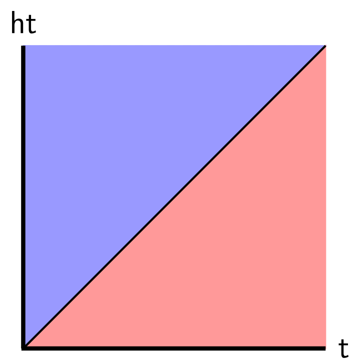
Here's the proof:

> Suppose that t is present at ht and t' is present at ht' where $ht' > ht$, $t \neq t'$ and t, t', ht and ht' are arbitrary. We know that for any hypertimes $ht' > ht$, $p(ht') > p(ht)$, so we know that $t' > t$. Now, pick an arbitrary $t*$ such that $t < t* < t'$. By (P3), every $t! < t'$ is just past at ht' and every $t! > t$ is just future at ht. So, because $t > t* > t$, it follows that at ht', $t*$ is just past and at ht, $t*$ is just future. By (P4) there's an $ht*$ such that $ht < ht* < ht'$ at which $t*$ is present. Because $t*$ is arbitrary, the reasoning generalises to every time in the interval $[t, t']$. □

With (C4) in hand, we then assume that time and hypertime are *finite* and add the following principles to the dialetheic model:

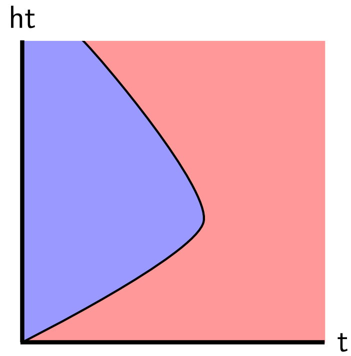
> (P7a) The first time is present at the first moment of hypertime.
>
> (P7b) Whichever time is present at the last moment of hypertime is the last moment of time.
>
> (P7c) The first and last moments of hypertime are distinct.

Let the first moment of time be t and the last moment of time be t'. We know that because the last moment of hypertime is later than the first moment of hypertime, that therefore $t' > t$ (since, again, for any hypertimes $ht' > ht$, $p(ht') > p(ht)$). Thus, we know that the first time that is present is before the last moment that is present. From (C4) we can thus establish that every moment in the interval $[t, t']$ is present at some moment of hypertime between the first and last moments. We also know that the function that maps moments of hypertime to times that is present is continuous, and strictly increasing, and has a constant rate of one t per ht. Putting this all together, then, we can model the passage of time as follows:



Note that as with the discrete case, the model rules out cases where the present moves backward or jumps. In continuous time, the present jumps from t at ht to t' at ht' where $t > t'$ and $ht > ht'$ if it doesn't pass through any times between t and t' in the period between ht and ht'. That's ruled out by (C4): if t is present at ht and t' is present at ht' then each time between t and t' is present at some hypertime between ht and ht'.

For the case where the present moves backward: if, as above, we take the present to be a continuous function, then to take account of the present going backward, we need a curve like the one depicted below. Any such curve will require that the present slows down: direction change for a continuous curve requires a change in rate. Since the present proceeds via a constant rate, there can be no change in direction, and so the present cannot move backward. Reversals are also ruled out as in the discrete case: they require times that are just past to regain the property of being future (see below, where the curve cuts back into the blue region).



Thus, (C2)–(C4) handle the continuous case, allowing us to explain why the present is always moving, into the future at a constant rate.

4. Comparing the Explanations

Having outlined the dialetheic explanation, I will now compare it with Skow's. The core features of the two models can be compared as follows:

Skow's Explanation	**Dialetheic Explanation**
Gaps	Gluts
Past/future infinite	Past/future finite
Physical state must change	Physical state need not change
Past is fixed	Past is fixed
Future and present times can change	Only future times can change

The dialethic picture requires contradictions, and thus truth-value gluts. As discussed, Skow's view requires indeterminacy (see principles (1b)–(1c)). On his picture, there's no fact of the matter as to what state the universe is in at a time until that time is visited by the present, which suggests a need for truth-value gaps. This is crucial: a change in the superstate only happens when the movement of the present makes a previously indefinite physical state of the universe definite. Gaps and gluts, however, require very similar revisions to classical logic and so there may be a kind of duality between them (Parsons 1990). Typically speaking, gaps require giving up the law of excluded middle and bivalence. Gluts, by contrast, require giving up the rule of explosion, but are generally compatible with bivalance. So either way, something classical has to go. It is thus difficult to find much daylight between gaps and gluts, at least not without first settling on a range of broader issues (see Hyde (1997) and Beall and Colyvan (2001); Hyde (2001) for discussion). So the two models appear matched in this respect. That said, Skow doesn't explain why gaps are removed when the present arrives. By contrast, my model does explain why dialetheia are removed, which is a bit better.

Both accounts require that the past is fixed, and that other times can change. For Skow, the future and present can change. On my picture, only future times can change. Note, however, that this implies that present and future times can change, because the present is future. Note also that Skow requires that only the future and present can change: the past cannot. So the two pictures require very similar conditions. Another point of similarity is that both accounts require that times only shift from being just future to being just past by first being present (note that on Skow's model, being future seems to imply being just future and being past seems to imply being just past, so the two models appear committed to something like (P4)).

Skow's view apparently requires that time and hypertime are infinite. The dialetheic model, at least with (P7a)–(P7c), requires that time and hypertime are finite. As discussed, however, the dialetheic works with infinite time and hypertime. It's just that there will always be times that are future or past that are never present. Whether that's a serious problem is unclear. For this may just be what one should expect of a moving present in the case of infinite time. The present is always moving, but it's moving through an infinite time series and so even if it moves for an infinite amount of time, there are always more times that it doesn't or didn't reach. If that's right, then perhaps the dialetheic model can be used to model both infinite and finite time, thereby capturing more cases than Skow's model.

The main advantage of the dialetheic model, however, relates to change. Skow's picture requires that the physical state of universe is always changing. The dialetheic model, by contrast, is compatible with the physical configuration of material entities within the universe remaining constant for all time. As Skow recognises, his approach conflicts with physical models of our universe. However, he maintains that when our physical and metaphysical theories clash, it's the physical theories that should give way (Skow 2012: 240).

This style of reasoning privileges metaphysics over physics, which conflicts with plausible versions of naturalism. Given naturalism, if we are to reject some aspect of our physical theories, it should be on scientific, not philosophical, grounds. Of course, when we're dealing with A-theories we may be forced into conflict with science at some point. Still, a harm minimisation principle seems sensible: we should seek to minimise the conflict between metaphysics and physics wherever possible.

One might respond that the conflict between Skow's picture and physics is not so bad. At worst, it rules out vacuum solutions of general relativity: solutions to the Einstein field equations in which there's apparently no material content to spacetime (and arguably nothing to change). But the conflict is worse than that: Skow's model is incompatible with any world in which there's any, even short, period of time where nothing changes. This rules out a great deal of possibilities that are ratified by physics.

On balance, then, the dialetheic explanation is preferable to Skow's. It's downsides are no worse, and the upsides are substantial. This is not enough to drive A-theorists toward dialetheism, however. For that, I must show that the dialetheic explanation is better than leaving the motion of the present unexplained. It is to that task that I now turn.

5. Non-Explanatory A-theories

Leaving the movement of the present unexplained lowers the explanatory power of one's A-theory. For this to be preferable, the cost of the dialetheic explanation must be so high that the A-theorist is better off taking the motion of the present as brute. To show that's not the case, I will consider each feature of the dialetheic explanation. For some features, I argue either that they're shared by the brute option or are features A-theorists should or do accept. These features therefore don't trade-off against the explanatory power of the dialetheic explanation. For features that are new, I argue that any associated costs of these features are too weak to outweigh the dialetheic explanation's benefits.

Let's begin with (P1a). This is based in two ideas. First, some time is present. That's needed for any A-theory. For without it there's no present to move. Second, the present can't be created or destroyed. By that I don't mean the presentist idea of present entities being created and destroyed. The focus, rather, is on anything being present at all. What we don't have is a world that shifts from being B-theoretic—there's no objective present—to being A-theoretic—there's an objective present—or vice versa. This is a fairly standard way of thinking about the A-theory. It also seems to be needed by the brute option. Without it, it's difficult to explain why the present doesn't come into existence in, say, 1922 and then pop out of existence in 2020. Putting these ideas together: if some time should be present and it can't be created and destroyed, then it shouldn't come into or go out of existence in hypertime. That gives us (P1a): at every ht some t is present.[6]

Next: (P1b), (P2a) and (P2b). (P1b) says that every moment of time is either past, present or future; there are no 'temporal gaps'. This is an intuitive feature of time, and one that is found in A-theories quite generally. We can thus expect this to be part of the brute option as well.

(P2a) captures the 'contradiction minimisation' condition from §3. As discussed, this is explained in terms of the instability of temporal dialetheia, which is assumed as a basic feature of the model (a point I return to below). (P2b) says that if a time is just past, then it stays that way, which explains why dialetheia can't reform. As discussed, this feature of the explanation is based on the idea that only future times can change their temporal attributes. The dialetheic explanation requires this, along with the idea that the past is fixed: if something is past it cannot lose this feature. The brute option requires similar assumptions. Present and future times must be capable of changing their temporal attributes (by ceasing to be present or future, which is also part of my view), otherwise passage is impossible. Moreover, only future times can change in this way on the brute option and so past times are fixed as past. Without this there's no way to rule out odd cases in which past times cease being past as time passes.

Next: (P3)–(P5). (P3) captures the idea that the present is where the past and future meet, in this sense: every moment later than the present is just future and every moment earlier than the present is just past. This is a recurring theme in the philosophy of time: the present is often conceived of as the knife-edge between the past and future. This is also a standard feature of the A-theory and one that we find in the brute option as well: the present never sits between two future times or two past times. (Note that on the brute option, a principle along the lines of (P3) need not explicitly mention being *just* future or *just* past, unlike for the dialetheic explanation. But being future and being past are equivalent to being just future and just past on the brute option, so this is not a serious difference. The same applies to (P4) below.)

(P4) captures the idea that for a time to shift from being just future to being just

[6] As noted, hypertime is introduced to analyse what it is for the present to move and then used as a framework for explaining why it moves. If the brute option uses the same framework, then there's no difference with the dialetheic explanation. If it uses a different framework, I am confident the dialetheic explanation can be rewritten in those terms, since what matters is the generation and annihilation of contradictions; hypertime is just a device for making this precise. Thus, aversion to hypertime doesn't clearly support the brute option.

past, it must first be present, whereas (P5) is the requirement that the motion of the present is continuous. Similar principles are needed by the brute option. (P4) is needed to rule out cases in which times shift from being future to being past by leapfrogging the present. Ruling this out is important because it is partly constitutive of passage that future times transition to past times only via the present: the present mediates any change in temporal attributes. (P5) is needed to rule out jumps: cases in which the present moves from one moment to another without passing through any moments in between.

For (P6), it would be odd for this principle to be false. For then the past would grow at a different rate to the rate at which the present moves. This is not something that we generally find in A-theories. Typically, the rate at which the past grows and the rate at which the present moves are locked together. Indeed, if the two rates are not locked, then it would be possible for (say) two times to become past as the present moves, even though just one of those times was present. This seems to reopen the possibility of cases in which times shift from being future to being past without first being present. As noted, this is something the brute option should rule out, so we can expect (P6) to be part of that option as well.

The principles at (P7) are ways of spelling out a finite universe. Here, it seems, there's a difference between the brute option and the dialetheic explanation. For the brute option is compatible with both finite and infinite cases; whereas the dialetheic explanation is tailored for the finite case. As noted, however, the principles at (P7) are not strictly needed, since the account works without them. That said, the infinite case does carry some potentially odd consequences.

Note, however, that the dialetheic explanation seems to have an advantage in the finite case that balances this out. Recall the principle that, if the present moves, then for any time t that is present, t was future. As before, if the first moment is present, then it was future. But the only way for the first moment to have been future is if, in the past, it was future. But how can that be? For the first moment, there are no previous moments, and so apparently no way for the first moment to have been future in the past. The dialetheic model supplies an answer: the first moment is both past and future and so, for that moment, it can be future in the past, despite there being no earlier moments.

Note that no such answer is available for the brute option. Note also that it is hard to see how else to accommodate this principle. Thus, either the principle must be endorsed without explanation or restricted so that it does not apply to the first moment (thereby avoiding the need for further explanation). As discussed, the second option leads to a disunified picture of passage, while the first requires another brute fact. Either way, the brute option seems to carry some cost in the finite case. Accordingly, even if the dialetheic explanation has a cost in the infinite case, there's still no clear basis to prefer the brute option.

This leaves us with the nature of the present. Here, one might argue, the brute option has an advantage, for it operates with a standard conception of the present. Namely: a third primitive category over and above being past or future. In fact, the dialetheic picture has the advantage. Being present is reducible to being both past and future and so fewer primitive temporal properties are needed.

In sum, the dialetheic explanation and the brute option share many assumptions, including: some time is present; the present can't be created or destroyed; the past is fixed; the present and future can be changed and only the future can be changed; the present is where the past and future meet and the motion of the present is continuous. Furthermore, the two options appear matched for the cases they can handle (finite vs. infinite). The brute option, however, needs three primitive temporal properties plus the following brute facts: (i) the present moves (ii) toward the future (iii) at a constant rate. The dialetheic model explains these facts, using only two primitive temporal properties and drawing on just one further feature: that some contradictions are unstable. While this is a basic feature of the model, the model still gets by with fewer basic features than the brute option and so, in this way, the dialetheic explanation is better: it explains more with less.

One might disagree: an explanation featuring contradictions is always worse than any consistent explanation. That's because contradictions are ruled out *a priori*. As Priest (2006) has argued, however, contradictions cannot be ruled out *a priori*. One might thus concede that contradictions are possible but hold that invoking them is never worthwhile. But this is also implausible: as dialetheists have argued, contradictions are worth invoking in explanations.[7] Another way to press the objection is to argue that invoking dialetheia to explain passage is not worth the benefits highlighted above. But the explanatory gains are substantial. So, one must identify a serious cost indeed. What cost might that be? I have no idea, and I'm not sanguine about the prospects of finding it.

It's tempting to leave the matter there: without some cost, the objection cannot be sustained. But there's perhaps a bit more to say. For even if dialetheia are costly, A-theorists may require them anyway. Three tentative considerations point in this direction.

First, consider the Leibniz continuity condition (LCC), which Priest (2006: 166) states as follows:

> Anything going on arbitrarily close to a certain time is going on at that time too.

By virtue of being the point where the past and future meet, the present is arbitrarily close to each. So the present is both past and future. The LCC is plausible (see Priest (2006: 165–9) for a defense). If one adopts the principle, however, then a dialetheic picture of the present is compelling.

Next, consider a process ontology. In a process ontology the world is fundamentally dynamic, characterised by a continual process of becoming. One way to construe the present on this view is as a point where everything is simultaneously coming into and going out of being. Assuming 'coming into being' implies 'not going out of being', the present thus involves a contradiction. The process theory is a compelling way to construe the A-theory, since it captures the fundamental dynamism that motivates the view. If A-theorists should be process theorists, however, then this provides another potential road to dialetheism.

Third, consider again the claim that if the present moves then, for any time t that is present, t used to be future. As discussed, to accomodate this principle in the finite case it seems the first moment should be both past and future. So, one present moment in one possibility is dialetheic. Plausibly, however, the present never changes it's nature and has its nature necessarily. If that's right, however, then the present should be dialetheic at every time in every possibility.

[7] See, for instance, Weber et al. (2014) who argue for dialetheism against Beall (2014). See also Priest (2014) and Baron (2022).

These considerations suggest the dialetheic explanation is not just the best *available* option, it is the best *possible* option. For if A-theorists require dialetheia, then a dialetheic explanation of passage is hard to resist. For now, however, I will settle for a more modest conclusion: of the available options, the dialetheic explanation is the one to beat. That's significant, as it shows that being a dialetheist is currently the best way to be an A-theorist.[8]

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References

Baron, S. (2022) 'Inference to the Best Contradiction?', *British Journal for the Philosophy of Science*, DOI: 10.1086/720172.

Beall, Jc (2014) 'Finding Tolerance Without Gluts', *Mind*, 123: 791–811.

Beall, Jc and M. Colyvan (2001) 'Heaps of Gluts and Hyde-in the Sorites', *Mind*, 110: 401–8.

Deasy, D. (2018) 'Skow on Robust Passage and the Moving Spotlight theory', *Philosophical Studies*, 175: 1791–1805.

Deng, N. (2013) 'Our Experience of Passage on the B-theory', *Erkenntnis*, 78: 713–26.

Hyde, D. (1997) 'From Heaps of Gaps to Heaps of Gluts', *Mind*, 106: 641–60.

Hyde, D. (2001) 'A Reply to Beall and Colyvan', *Mind*, 110: 409–11.

Leininger, L. (2021) 'Temporal B-coming: Passage Without Presentness', *Australasian Journal of Philosophy*, 99: 130–47.

Oaklander, N. L. (2015) 'Temporal Phenomena, Ontology and the R-theory', *Metaphysica*, 16: 253–69.

Parsons, T. (1990) 'True Contradictions', *Canadian Journal of Philosophy*, 20: 335–54.

Pooley, O. (2013) 'Relativity, the Open Future, and the Passage of Time', *Proceedings of the Aristotelian Society*, 113: 321–63.

Priest, G. (1985) 'Inconsistencies in Motion', *American Philosophical Quarterly*, 22: 339–46.

Priest, G. (1992) 'On Time', *Philosophica*, 50: 9–18.

Priest, G. (2006) *In Contradiction*, 2nd edn. New York: Oxford University Press.

[8]A version of this paper was presented at the *Time and Contradiction* Workshop at the University of Geneva, 2023, organised by Baptiste Le Bihan and Vincent Grandjean, and at the *Time, Space and All the Rest* workshop at the University of Sydney, 2023, organised by Kristie Miller. I am grateful to audiences at both events for their helpful feedback. I am also grateful to two anonymous referees of this journal for their helpful comments.

Priest, G. (2014) *One: Being an Investigation Into the Unity of Reality and of its Parts, Including the Singular Object which is Nothingness*. Oxford: Oxford University Press.

Skow, B. (2012) 'Why Does Time Pass?', *Noûs*, 46: 223–42.

Tallant, J. (2015) 'The New A-theory of Time', *Inquiry: An Interdisciplinary Journal of Philosophy*, 58: 537–62.

Weber, Z., D. Ripley, G. Priest, D. Hyde, and M. Colyvan (2014) 'Tolerating Gluts', *Mind*, 123: 813–28.

Zardini, E. (2019) 'Instability and contraction: Méditations Hégéliennes I.' *Journal of Philosophical Logic*, 48: 155–88.