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ORIGINAL RESEARCH

Unsettledness in times of change

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Abstract
If something changes from being in one state to being in another state, when exactly does it change? And what's going on at that time? These questions are often discussed under the heading of the 'moment' or 'instant' of change. In this paper, I will investigate a view on which there is an intrinsically distinguished, atomic time at which something changes, and at that time it is metaphysically indeterminate what is the case. The background metaphysical picture is situationalism, a theory on which reality is composed of irreducibly conflicting parts. These conflicting parts give rise to unsettledness in reality as a whole, and also (I will suggest) at the point of change. I propose this view as a competitor for existing accounts of the time of change, and spell out a few reasons in its favour.

There are many philosophical puzzles about change. One puzzle of ancient pedigree concerns the precise time at which something changes from being in one state to being in another. Suppose you strike a match. The match has changed: to start with it is unlit, and afterwards it is aflame. There are a series of earlier times in which the match is unlit and a series of later times in which it is aflame. But there also seems to be a time at which it moves from being in the former state to being in the latter state. This is the time of change, the exact time at which the match alights.

There is a long history of reflection on times of change, in many philosophical traditions.[1] Times of change have often been taken to be moments, i.e. instantaneous

[1] For a brief introduction to the general issues concerning times of change see Mortensen (2020) (esp. Section 4). Aristotle is a central figure in this area, and he is reacting to earlier discussions of change by, among others, Parmenides and Plato. His own hugely influential views are in the *Physics* VI and for a modern discussion of the Aristotelian approach see, for example, Sorabji and Kretzmann (1976).

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slices of time of zero duration. It is therefore under the banner of 'the moment of change' (or sometimes 'the instant of change') that some of the discussions of the phenomena I'm interested in have been conducted.

Two special sorts of change have been prominent in these debates, and are worth mentioning. The first is motion (or change of place), for instance when a ball goes from being at rest to moving. The second is an entity's coming into and going out of existence, for instance when Socrates dies. Because I am interested in the most general form of the issues surrounding times of change, however, I will treat all cases of change together.[2] In all such cases, the time of change is the point of transition. Put in general terms, when an object O changes from being F to not being F, the time of change *t* is the exact time at which it is changing from being F to not being F.

There are several philosophical questions about times of change. Two of the most prominent are: when, exactly, do things change? And the subsequent question is: what state is the changing entity in at the time it's changing?

My aim in this paper is to make progress on one particular account of times of change, according to which there is a single, atomic time at which things change and at that time it is indeterminate what state they are in. So, if O changes from being F to being not F at *t*, then the time *t* is a minimal (possibly instantaneous) temporal duration and O is neither F nor not F at *t*. I will articulate this view within a more general framework for change on which the status of a changing entity is metaphysically indeterminate. This positive proposal comes in the second half of the paper (Sect. 2).

Before I get to the positive proposal, however, I want to lay out the alternatives and consider reasons why they might be found unsatisfactory. To be clear, the reasons I offer will only be indicative, and it is not a primary purpose of the paper to provide decisive arguments against the other options. Nevertheless, I do think that the indeterministic approach I'll outline has some advantages. I am not offering it merely to colour in the map of conceptual space. The next section (Sect. 1) will indicate the alternatives I have in mind and suggest some problems with each these views.

The questions of precisely *when* things change and of *what's going on* at this time intersect in various ways with more general philosophical debates about time and change. Three particularly important issues are (i) the structure of time; (ii) the nature of time; and (iii) the nature of change. Rather than give a systematic overview of these, I hope these connections will emerge organically as the discussion unfolds.

Strobach (1998) offers a book-length treatment with a detailed history of the subject, while Goubier and Roques (2018) focuses on issue in the medieval context (though note the retraction of the introduction and the Roques paper). The moment of change is also debated in the Islamic *falsafa* and *kalam* traditions which (speaking broadly) incorporate and react to the Aristotelian and wider peripatetic tradition. See Ibn Sina's *The Healing* (Ibn Sina. 2010) as an important primary text, and McGinnis (2018) for a general introduction to Islamic treatments of change. In more recent times, Priest (2006) is an example of a dialethic approach to the matter.Interest in the moment of change is not limited to Western philosophy: to give just one example see the comparative discussion of Priest and the Buddhist philosopher Dharmakīrti in Mortensen (2004) and Tanaka (2007).

[2] In particular, notwithstanding the Kantian dictum that existence is not a predicate, for the sake of this paper I will assume that times of changing between having and lacking a property and times of changing between having and lacking existence should be considered univocally. I will supress the details of the distinction between having and lacking properties and having and lacking existence for the rest of the paper.

It is worth bearing in mind, however, that there are undercurrents of this sort below the surface.

1 When do things change?

It is uncontroversial that things change (or, at least, it should be).[3] To return to example of lighting a match, it is clear that it is first unlit and afterwards on fire. This process of change takes place in time, and so there is an earlier time at which it is not on fire and a later time at which it is. In one sense, this is enough to answer the question of when the change takes place: we might say that it alights in any time period which contains both a time in which it is unlit and a time in which it is aflame. So, for instance, it alights on Monday, or while the dinner was being made.

But there's another sense in which these answers aren't quite enough. When *exactly* did the match alight? It is this sense of the question which I am interested in here. Correspondingly, while there is a sense in which any time which contains a change is a time of change, I am concerned with the times which are the *precise* times at which something changes. Specifically, a time of change in my intended sense is a minimal period during which an entity changes. The time of change for the match's being lit is the smallest time that contains its changing with respect to being on fire.

To answer the question of when something changes, then, we need to find the minimal time in which it changes. I will consider three possible options here.

1.1 No time of change

The first view is one according to which there is *no* time which is the exact time at which something changes. In other words, there is no minimal period which contains a change. Thus the answer to the question of exactly when something changes (understood in this sense) is: never.

On the face of it, such an answer seems odd. How could something change without there being a precise time at which it changes? One way this could happen has to do with the structure of time. The topology of time is a major topic in philosophy and in physics. The specific position I wish to discuss is one on which there are no points of time, but only periods of time. In other words, there is no time which is an instant, but rather all times are extended. By itself, this is only enough to rule out that there is an *instant* of change, but not that there are times of change. For example, if there are minimal durations of time then one such duration could be the smallest time which contains the match's changing from being unlit to aflame. (Indeed, this is why I am framing my discussion in terms of *times*, rather than *moments* of change.) But maybe time lacks not only instants but also any minimal durations at all: perhaps time is infinitely divisible. On this view, there are periods of time of ever-decreasing duration without there being any instantaneous moments of time.

[3] Of course, there are philosophers from at least Parmenides onwards who have denied this. But I will be assuming that things do in fact change.

If time has such a structure, then there is a model for change on which no time is the exact time of change. On this model, when the match changes from not being on fire to being on fire there will be many times which contain this change. But each of these times can be sub-divided further into smaller periods of time, only one of which will contain this change. So every time containing the change will have parts which themselves do contain that change and parts which do not. This process iterates, so there will be no time period where the match is changing throughout the whole of it. Nor will there be any *smallest* period of time in which the match changes from being unlit to being alight. This means that there is no single time period which is the unique time of change as I have defined it.

To spell this out, let's consider O's changing from being F to not being F in an extended time period *t.* According to the model under consideration, in any division of t into two parts t_1 and t_2, O's changing from being F to not being F will be contained in exactly one of t_1 and t_2. The other time period will be one in which O is just F or just not F, depending on whether it is t_1 or t_2 that contains the change. This process repeats with t_1/t_2 such that *every* time has a proper part in which the change is absent and a proper part which wholly contains the change. So there is no smallest time in which O changes.

On this model there are no times which are the exact times at which things change. This means that there just are no times of change. So, there would be times in which things change, but no times of change. This renders the subsequent question obsolete (namely, the question of what state the changing object is in at the exact time it's changing). One good strategy for difficult questions is to avoid them, and this approach seems to manage that trick.

I now turn to reasons to be unsatisfied with this account of times of change. The first point to note is that the structure of time outlined does not by itself settle which times contain a change. It is the particular *model* of what's going on in such a topology which assigns the location of the change. Although I think the model above is indeed the natural way to fill out the topology, it is not the only one available.[4]

An example of a different model is the following: within an infinitely divisible time period there are times which contain the change and which are such that *all* their sub-intervals also contain that change. Dividing such a time t into parts t_1 and t_2 would mean that O's changing from being F to not being F is occurs throughout *both* t_1*and* t_2. This could therefore secure a unique time which was the *largest* time whose parts all contained the change. This time (and all its sub-intervals) would not have any proper parts in which the change was absent, and so could lay claim to being a time of change in a slightly different sense to my intended one: in this model there is no *smallest* time in which the change happens, but there *are* times which the change extends throughout.

The second model does strictly speaking avoid there being a time of change in the sense I've articulated. But it's obvious that there's still a difficult question about what the status of the changing object is in those times which contain no proper parts where it is not changing. This is effectively the same puzzle which we will encounter

[4] The interesting possibility I discuss in the next paragraph was raised with me by Gonzalo Rodriguez-Pereyra, and I am grateful to him for it.

in Sect. 1.3, and so this model doesn't really avoid the problem (nor, I think, is it intended to: it can be combined with the dialetheist view spelt out in 1.3 or indeed my own proposal in Sect. 2). Given that at least one model of change within such a structure needs to face the parallel question, the issue then becomes why we should accept the first model over the second. To put it in other words, it isn't so clear after all whether time's being structured in this way is enough to avoid the problem of saying what's happening in times when something changes.

There is a second reason to doubt this approach as solution to the original problem of saying when things change and what happens at the time they do. Such a view of the structure of time, whereby it has no instants and its periods are infinitely divisible, is controversial. It should make us wary that this approach is tied to a contentious view in the topology of time. I don't take this to be a knock-down objection, as time could turn out to have this structure. But from a methodological point of view, it would be problematic to *require* time to have this structure in order to avoid the issue of the status of a changing entity at the minimal time in which it is changing. Our metaphysics shouldn't drive our physics in so direct a way.[5]

To repeat: I do not take these to be decisive reasons to reject the picture of change outlined in this section, merely an indication that it might be worth canvassing the alternatives. I turn next to one of the most popular such alternatives, namely the Russellian view of change.

1.2 Complex times of change

A second picture of how a changing object's states map out across time takes times of change to be complex, i.e. to have parts. On this view, the question of *when* something changes receives an answer which spans more than one minimal time.

This is the standard B-theoretic account of change, paradigmatically associated with Russell.[6] B-theory is the view that no time is metaphysically special and that reality is fundamentally tenseless. The typical B-theory account of change conceives of it on the model of variation across space. On this view, change is simply a matter of having different properties at different times, just as spatial variation is a matter of having different properties in different places.[7] When something varies across space, we see no need to postulate a single place as the place where it is spatially varying: it varies *across* the space. Analogously, there is no need to posit a single time at which something is changing: the object changes *over* time not *at* a time. Thus if O changes

[5] This is a methodological claim but not, I think, an especially contentious one. While the extent to which physics should constrain metaphysics (or *vice versa*) is a controversial matter, it would take an extreme view to think that armchair reflection on times of change should determine a question about the topology of time. See Ladyman and Ross (2007) for a full-blooded defence of the idea that metaphysics must be driven by the natural sciences, but my point here requires nothing anywhere near the strength of this naturalistic approach.

[6] A commonly cited passage in which Russell expounds his approach is the following:"Change is the difference, in respect of truth or falsehood, between a proposition concerning an entity and a time *T* and a proposition concerning the same entity and another time *T'*, provided that the two propositions differ only by the fact that *T* occurs in the one where *T'* occurs in the other." (Russell 1937: 469).

[7] There are different ways to cash this out, including temporal parts theory, relational properties views and adverbialism. I will return to these below on p10.

from being F to not being F, there will be a time *t*- at which it is F and an adjacent time *t*+ at which it is not F, but no time between these in which it is actively changing. There is no single time, then, at which a change occurs, but only pairs of times such that they jointly constitute a change.

This means that the minimal time in which a change occurs will be a conjunction of two times: a time in which it is in the former state and a time in which it is in the latter state. More precisely, it is the conjunction of the *last* time in which it is in the former state and the *first* time in which it is in the latter state, otherwise there would be many different such pairs. (Note that these times need not be instantaneous: they could be durations.) So times of change, on the Russellian view, are not atomic but complex. When does the match change from being unlit to alight? At the time composed of the last time it is unlit and the first time it is aflame. What state is match in at the time it changes? It is unlit in one (temporal) part of that time and aflame in another. Because the time of change is complex, it can be in more than one state across that time.

The Russellian view of change is popular, indeed it is near universally accepted by B-theorists. Nevertheless, there are reasons to worry about it. A-theorists (who think that there is a specialness to the present time) generally accuse the Russellian account of change with being insufficient to capture the genuine sense of *transition* from one state to another. Priest, for instance, has pejoratively labelled it the 'cinematic' account of change (see his 2006). It isn't quite clear what to make of this criticism, but I suspect it has to do with the fact that on the Russellian view the time of change is not intrinsically distinguished from any other. The time of change is special because it contains the *final* time at which the match is unlit and the *first* time at which the match is alight. The times *t*- and *t*+ are therefore privileged extrinsically, in virtue of the non-existence of later/earlier times where the entity is in the same state. But in their intrinsic features, the time *t*- does not differ from the preceding times when O is F and *t*+ does not differ from the subsequent times when O is not F. For this reason, the pair *t*-- and *t*++, which are earlier and later than *t*- and *t*+ respectively, doesn't differ intrinsically from the actual time of change.

I doubt the defenders of the Russellian view will be concerned by this. They are unlikely to accept that the times across which something changes needs to be intrinsically distinguishable from times when it stays the same. It can be seen as part of their package that when a change happens is determined extrinsically by what is going on elsewhere in the 4D manifold.

There is a more worrying concern lurking, however. It is part of the Russellian view (as I've stated it) that the component times which combine to provide the time of a change are adjacent, i.e. are the last and first times of the relevant states. But this encounters difficulties if time is continuous, and time is standardly taken to be a continuum.

If time is continuous, then it is infinitely divisible and there is a time between any two moments of time.[8] This means that no two times are properly adjacent. If no two

[8] Strictly speaking, all that is required for this is that time is dense, where density is the property of having an element between any two elements in a series. A continuous series is one that has the further property of being able to be put into a one-to-one correspondence with the real numbers but not the rational num-

times are next to one another, then the Russellian view can't be as straightforward as I've described it. It cannot be that the time of change is a pair of adjacent times, because no times are properly adjacent. This means that there cannot be both a last time that O is F and a first time that O is not F such that these two times compose a complex time of change. The question of *when* something changes looks difficult for the Russellian to answer if time is continuous.

There are ways to try to deal with this. The first recognises that in continuous time we can identify a last time at which O is F *or* a first time at which O is not F, but not both. This is because once one of these two has been identified, there will always be a time between this and any other time. No time immediately follows another, so if there is a last time at which O is F there cannot be a first time at which it is not F (and *vice versa*). One state the changing object is in will occupy a closed interval, and the other an open interval. At this point, we could maintain the same metaphysical picture and engage in some relabelling. We can identify either the last time at which O is F or the first time at which O is not F, and then call *this* the time of change. On this variant of the view, times of change are atomic after all: the time of change is no longer considered to be the conjunction of *t*- and *t*+ but rather one of these two. Depending on which time is chosen as the time of change, the changing object will be only F or only not F at the time it changes from being F to not being F.

A difficulty with this approach is that it's hard choose between *t*- and *t*+ as the time of change. Picking between them can seem arbitrary. For some properties there might be principled reasons why the last time of a certain state (rather than the first time of the subsequent state) is the time of change between these states. For instance, the first time of motion might be a better candidate for the time of change than the last time something is at rest.[9] But it is hard to countenance this for *all* sorts of change. If something changes colour, why would the last time it is green, rather than the first time it is blue, be the time it changes? No reason seems forthcoming.

Further, as noted, if the time of change is the last/first time of a certain state this also has the consequence that at the time it changes an entity is in just one of these states. For instance, the match is unlit (say) at the time it changes from being unlit to aflame. But this, too, seems arbitrary. Why say that it is unlit, rather than aflame, at the time it alights? It seems an odd account of what's going on at the time at which something changes that it is simply in the same state it was in before, albeit that it is the last such state.

So, I suggest this view, which I take to be a notational variant of the standard Russellian picture, does not help us understand times of change in continuous time.

A second way the Russellian might proceed is to just deny that time is continuous. But this is not the right move. Not only does it commit us to a controversial position on time's structure, but it does so for a bad reason. While time might or might not be continuous, metaphysical speculation on exactly when things change is a bad reason to think it is not. I've made a similar methodological point above (p4): much

bers. Continuous series are dense, but not all dense series are continuous (e.g. the rationals are dense but not continuous).

[9] See Sorabji and Kretzmann (1976) for discussion of such an approach.

as reflection on times of change shouldn't require the topology of time outlined in Sect. 1.1, it also shouldn't rule out that time is continuous.

A final response I'll mention is the one I anticipate most Russellians adopting. They might just claim that there's no good answer to the question of when things change in continuous time, and that this isn't a problem. For each time, there will be a state that the changing entity is in. But there will be no pair of times that compose the minimal time in which the entity changes. Thus the match alights, but there is no exact time (even a complex time) at which it does so.

In effect, this moves towards the view discussed in 1.1, where there are just *no* times of change. How acceptable this is will be contested. It certainly contravenes otherwise plausible principles such as the following: *if something happens in time then there is a precise time at which it happens.* For the change happens in time, but there is no precise time at which the change happens. Nevertheless, this could be chalked up to the difficulties of theorising about continua, and it's certainly true that odd things happen with infinities of this sort.

So, to repeat and underline the point, I don't take the difficulty I've articulated as fatally undermining the Russellian account of change. I do think, however, that it puts pressure on it. It seems puzzling that something could change when there isn't any precise time at which it is changing. It also seems puzzling that, for that reason, there's nothing to say about what's the case at the time at which an entity changes from being in one state to being in another. This motivates considering a different view, whereby there *is* a single, atomic time of change, and it is to views of this sort that I now turn.

1.3 Atomic times of change

The final account of times of change is one on which they are single, minimal times (often taken to be moments). On this way of thinking, there is a particular atomic time which is the time at which something changes: a specific t such that the match alights at t. There is therefore a straightforward answer to the question of when something changes: at the minimal time t.

What is less straightforward is the answer to the subsequent question: what is the state of the changing entity at the time at which it changes? For the changing O which is F before the change and not F afterwards, it seems there are the following options:

i) O is (only) F at t.

ii) O is (only) not F at t.

iii) O is both F and not F at t.

iv) O is neither F nor not F at t.

We have encountered options (i) and (ii) in the previous section, where I described a notational variant of the Russellian view on which we identify the last time of O's being F or the first time of O's not being F as the time of change. In these cases there is no intrinsic difference between what's the case at t and what's the case before/after t, but there is an extrinsic difference in t being the last/first time that O is in that state. As I've discussed these views already, I won't say more here.

Options (iii) and (iv) are alternatives where what is the case at t is clearly intrinsically different from what is the case at other times. The state a changing object is

in at the time it changes is distinguished from the states it is in before and after that change. For option (iii) this is because it is *both* F and not F then, whereas for option (iv) it is *neither* F nor not F then. Insofar as the time of change is supposed to be intrinsically distinctive, these options are preferable.

But option (iii) seems to state a contradiction. If, at *t*, O is both F and not F, then it is both true and false that O is F at *t*. If *t* is an atomic time, this means that a contradiction is true. Thus option (iii) is only open to those who countenance true contradictions. Indeed, the time of change has been given as a motivation for dialetheism (see, e.g. Priest (1982, 2006, 2017), Nozick (2001), Hegel (1812) etc.). But dialetheism has always been and remains an exotic view, so it's appropriate to treat (iii) as problematic on this basis.

This leaves option (iv). I intend to develop a version of this view, giving an account of times of change on which it is (metaphysically) indeterminate whether they have or lack the properties with respect to which they are changing. Before I do so, however, I will briefly note that some have claimed that option (iv) collapses into option (iii).[10] If this is true, then there's no point in pursuing option (iv) as a genuine alternative. The argument given is as follows. If it's not the case that O is F then O is not F. Similarly, if it's not the case that O is not F then O is F. Therefore, if O is neither F nor not F then it is both not F and F: this is the third option.

This argument is problematic for several reasons. I will set aside potential issues of scope and challenges to negation elimination, but just note that it's simply part of an indeterministic package that something not being true doesn't mean it's false: it can fail to be true and fail to be false by being indeterminate. Granted, this will involve considering revisions to classical principles such as excluded middle and bivalence, but it is question-begging to use such principles in an argument that (iv) collapses into (iii).[11]

Thus, I take the claim that O is neither F nor not F at *t* to be a distinct, positive proposal about what state things are in when they change. The proposal will no doubt be controversial, but it upholds a clear sense in which times of change are intrinsically privileged without entailing that some contradictions are true.

2 Indeterministic times of change

How could it be that O is neither F nor not F at the time it's changing from being F to not being F? I will outline one theory which would warrant such a claim, and spell out the background metaphysical picture within which the account sits. This gives at least one way to flesh out the idea that a changing thing is in an indeterminate state

[10] See Priest (1982, Sect. 2.3) for an argument to this effect (see also his 2006, Sect. 11.2 and 2017, Sect. 1). The first pages of Littmann (2012) give an argument which makes very similar moves. There are a number of ways to spell out an argument of this form, but the details are not essential here.

[11] Priest does note in his (2006) 11.2 that the argument involves exhaustion principles of the form: if p is not true then not-p is true. He gives reasons to accept such principles in different parts of the book, but I won't be engaging with these here. There are a plethora of non-classical logics and semantics available which accommodate indeterminacy. Sorensen (2018) gives some options for dealing with vagueness, which are examples of some of the possible formal approaches to indeterminacy.

at the exact time at which it is changing. I turn now to this background account of change.

2.1 Introduction to Situationalism

The broader metaphysical picture I have in mind is *situationalism*, a view of change recently outlined in Pickup (forthcoming). Situationalism is a view about what reality contains and how its parts are related to one another. Two core aspects of the account of change it provides are (i) that reality's parts fundamentally disagree about what is the case and (ii) that indeterminacy arises at the point of conflict between these parts.

The first of these claims is to be understood in a radical way: it is not merely that bits of reality have different things going on in them, but that what is the case in different parts of reality is really *incompatible* with what is the case in other parts of reality. What occurs in one portion of reality cannot co-obtain with what happens in another portion of reality. This incompatibility means that the situationalist belongs within the tradition of those who take reality as a whole to be disunified.[12]

The second of these points is also to be understood radically. The indeterminacy of situationalism is *metaphysical* indeterminacy: it is a matter of the world itself being unsettled with respect to how things are. This contrasts with merely representational indeterminacy, where the indeterminacy is located in representations of reality rather than in reality itself. The situationalist takes the world as a whole to be 'gappy', though its parts may be determinate.

As can already be seen, situationalism is a metaphysically committed theory. For its expression, it relies on *situations*. The quickest introduction to situations is to think of them as parts of possible worlds, though a situation theorist would express this as the idea that possible worlds are special, maximal sorts of situation. This isn't that informative without a description of the nature of possible worlds, however. As I use them, situations are akin to states of affairs or facts, and are composed of entities having properties and standing in relations. Situations are a formal tool with which to explain the situationalist account of the world, and situation theory is a rich area of theoretical work.[13] For our purposes here, it is sufficient to note a couple of features of situations: (i) situations can be parts of one another;[14] and (ii) what is the case depends on the situation under consideration, and varies from situation to situation.

So, there is a situation in which I am drinking tea in my house. This is part of a larger situation corresponding to everything that's happening in the U.K. right now. It is also part of a different larger situation corresponding to everything that happens in my house this week. The situation in which I am drinking tea in my house has as a

[12] One important such view is the Fragmentalism of Kit Fine, according to which fragments of reality do not cohere due to their irreducibly perspectival nature of certain facts (paradigmatically, tensed facts). See his (2005, 2006) and recent explorations in a small literature including Lipman (2015, 2016), Loss (2017) and Simon (2018). Moore (1997, 2019) also explores the possibility that reality is disunified for similar reasons, while Goodman (1978) invokes a different sort of incoherence in reality.

[13] For a flavour of situation theory and its application in semantics, see Devlin (2006) and Kratzer (2020).

[14] There's an interesting question about what mereology to adopt for situations. Though I will later point out a reason to think otherwise (see fn 17), for the sake of exposition it will be more straightforward to assume a Classical Extensional Mereology as described by, for instance, Hodva (2009).

part a situation in which a tea-mug is warm. It is separate from (i.e. disjoint from) the situation in which Jane is sky-diving in Colombia.

The truth-values of propositions are situation-relative because what is the case is situation-relative. It is true in the original situation that the tea-mug is warm. It is not true in the situation in which Jane is sky-diving in Colombia, because that situation is silent about my mug's temperature: it is neither true nor false in that situation.

The situationalist account of change exploits the fine-grained nature of situations and the fact that what is the case is situation-relative. It claims that when something changes, different portions of the world fundamentally disagree about the state of that thing. This disagreement involves strict incompatibility: what is the case before a change and what is the case after the change are unable to both hold. The object has a property in one situation and lacks it in another, where both situations are parts of the world as a whole. This might seem to augur badly: the world as a whole containing disagreeing parts looks like it leads to dialetheism. But the situationalist move is that in larger situations containing such disagreeing situations, the state of the object is indeterminate. In other words, reality itself becomes unsettled about what is the case when incompatible chunks are put together. This is the sense in which reality as a whole is disunified and fractured into a number of internally coherent pieces. Because of this, there is no part of reality in which a contradiction is true. This approach (I argue) maintains genuine incompatibility between pre- and post-change states of affairs without falling into contradiction.

Situationalism is B-theoretic, because all times are treated as metaphysically on a par and tense is not fundamental. B-theory is usually taken to rule out a strong sense of incompatibility between what is the case before a change and what is the case afterwards: this is a common objection to such views of change.[15] The standard menu of B-theory accounts of persistence through change involves temporal relativisation of object, property, or the instantiation relation.[16] This means that what is the case before the change is compatible with what is the case after the change. For instance, on the temporal parts view it is distinct objects (the-match-at-*t*- and the-match-at-*t*+) which differ with respect to whether they are aflame.

Situationalism can claim to have a significant advantage here, as it is a B-theory which permits genuine incompatibility in cases of change. It is the very same object, property, and instantiation relation in the situations before and after the change. The incompatibility between these is what means that reality as a whole, containing both situations, is disunified. This incompatibility, though, doesn't slide into contradiction because when these incompatible parts are put together the result is unsettledness (i.e. indeterminacy). Situationalism posits a picture of reality as fractured into irreducibly disagreeing parts.

A worked example might help to flesh out the view. The warm tea-mug on my desk will not remain warm. In due course, it will cool and become cold. So while the

[15] Priest presses such a charge (e.g. in his (2006 ch 11) and (2017)), but it also appears more widely, e.g. Oderberg (2004).

[16] These views are, respectively, perdurance (according to which objects have temporal parts), relational properties views (according to which properties are relations involving time), and adverbialism (according to which instantiation itself is temporalised).

tea-mug is warm in the situation mentioned above, it is cold in some later situation. Thus the proposition that the tea-mug is warm is true in the earlier situation and false in some later situation. (This is the case even though the tea-mug in each situation is numerically identical, the property of being warm is the same in each situation, instantiation is the same in each situation, and the situations are equally authoritative about what reality is like.)

There is a natural concern that, because these situations are both (and equally) part of the world, when considering the world as a whole we will get a contradiction: the proposition that the tea-mug is warm will be both true and false. But this only follows if what is true in any part of the world is true in the world as a whole. In turn, this relies on a more general principle that whatever is true in a situation is true in all extensions of that situation. This principle, *monotonicity*, is denied by the situationalist. The denial arises from a metaphysical picture where reality as a whole is fractured into chunks which are fundamentally at odds with each other about how things are. Because of this disagreement between the pieces of reality, it is not always the case that something true in a situation is thereby true in any larger situation which has the former as a part.

In the situationalist framework, there is then a question about how things are in the larger situations containing a change. What is going on with the tea-mug in a situation containing as parts both situations where it is hot and situations where it is cold? The answer is that the tea-mug is unsettled with respect to its heat. Correspondingly, the proposition that the tea-mug is warm is neither true nor false in the larger situation: it is indeterminate. This indeterminacy is metaphysical, rather than representational, as it arises from the unsettledness of reality rather than from any incompleteness in our description of that reality.

This concludes the brief sketch of the situationalist approach to change in general. Change, for a situationalist, is a matter of the world being divided between parts in which some entity is a particular way, and parts in which it is another, incompatible way. The metaphysical picture is controversial, to say the least. But the project here is not to directly defend this account of change, but to show how it can give one way of maintaining the idea that a changing thing changes at an intrinsically distinguished, atomic time and is in an indeterminate state at that time.

2.2 An indeterministic time of change within situationalism

I have set out, in brief, the situationalist account of change in general. The task now is to show how it might be able to treat *times* of change. I should say explicitly that I think situationalism is compatible with many different answers to the questions of when something changes and what its state is at that time. But my focus here will be on spelling out a version whereby the time of change is atomic and it's uniquely a time where the state of the changing entity is metaphysically unsettled.

The first step is to consider what's the case in a larger time period during which the change occurs. If we call this time period t^*, there will be a corresponding situation s^* which encompasses everything that happens at t^*. As described in the previous section, the situationalist picture is that O will be indeterminate with respect to F-ness in s^*. There will be parts of t^* before the change, and in the corresponding parts of

*s** O will be F. There will be parts of *t** after the change, and in the corresponding parts of *s** O will be not F. When any two such parts are put together, O's status is unsettled.

But we are now concerned with *t*, the time of O's change. Again, there will be a corresponding situation, *s*. What is the case in *s*? While several of the previously discussed answers are open to the situationalist, I'll claim that *s* is minimally temporally extended and that O's being F is indeterminate in *s*. This means that in *s* it is neither true that O is F nor that O is not F. This fits with the situationalist's broader acceptance of metaphysical indeterminacy.

Nevertheless, there is more to say here. In temporally extended situations containing a change, metaphysical indeterminacy arises in virtue of the situation containing parts which fundamentally and irreconcilably disagree about what is the case. When a situation in which O is F is combined with a situation in with O is not F, the resulting situation is indeterminate with respect to O's F-ness. In the theory, this very indeterminacy limns the boundaries of the determinate chunks of reality out of which the indeterminate reality as a whole is composed. But it isn't clear how this maps onto the situation *s* if it obtains at a minimal temporal duration. In the general account of change, the incompatible parts of reality which are put together are at a temporal distance, and so the larger situation is decomposable into determinate temporal parts which disagree about what is the case. But the situation *s* has no such parts.

So it seems that something unusual must be the case for *s*. There are different ways for a situationalist to approach this. She could simply to accept that *s* is atomic but nevertheless metaphysically indeterminate about O's F-ness. This has a disadvantage, though, in that it posits metaphysical indeterminacy at the fundamental level. One of the attractions of the situationalist picture is that metaphysical indeterminacy is emergent, as a feature of complex situations composed of incompatible parts. (This also allows a natural parallel to supervaluationist approaches to other types of indeterminacy.)

I propose, instead, to take *s* to be complex. Despite *t*, the temporal location of *s*, being atomic, the situation encompassing O's state at *t* has parts. But these parts are not *temporal* parts. In particular, I suggest that *s* is composed of two further situations, *s1* and *s2*, which are those in which O is F and O is not F, respectively. Thus the indeterminacy in the time of change arises from a conflict between two incompatible situations, and is of the same type as the indeterminacy the situationalist ascribes more generally in cases of change. The consequence of this is that two situations, *s1* and *s2*, are both part of reality at *t* and are incompatible.[17]

[17] One interesting question, raised for me by Mike Hicks, is whether there will be any difference between, on the one hand, the time of change from O's being F to O's not being F and, on the other, the time of change from O's not being F to O's being F. In other words, is there any distinction between coming to be F and ceasing to be F? There are options to be explored here.One could simply deny that there is any intrinsic distinction, so that the direction of the transition from one state to the other would be extrinsically determined by what's going on at other times. But I suspect the account will be more appealing if there is an *intrinsic* difference between changing in one direction and changing in the other.I would be inclined to appeal to non-extensional mereology at this point. While the standard Classical Extensional Mereology, as the name suggests, mandates that there is a *unique* situation composed of *s1* and *s2*, if we deny extensionality then there could be two distinct fusion of *s1* and *s2*, corresponding to different orderings of *s1* and *s2*. (These orderings, of course, would not be temporal.) The result would be that the situation at the time

This is unusual: normally at a time there will be only one (minimal) situation corresponding to a particular's status with respect to a property. Where O is not changing with respect to F-ness, the smallest situations containing O's having or lacking F will be no more fine-grained than time. This is not so at the time of change. It is here that the fineness of grain of situations is theoretically useful. Because situations can be finer-grained than time, the situationalist can distinguish between what is the case in different situations at a single (minimal) time.[18]

The fineness of grain of situations allows a situationalist to take the time of change to be atomic in the temporal sense, but complex in the situation-theoretic sense. There is only one time, but more than one situation at that time.[19] The rest of the story then follows the pattern of the situationalist's account of change in general: incompatible things are true in distinct situations which gives rise to metaphysical indeterminacy in larger situations of which they are both a part.

Any time period containing O's change will have a corresponding maximal situation in which O's state is indeterminate, just as *t* does. But *t* is special in being a minimal and atomic time period. The time of change can therefore be distinguished from all other times. Similarly, while many temporally extended situations will have sub-situations which display the same conflict (and hence contain indeterminacy), only *s* will have conflicting parts which are located at the same time.

The situationalist holds that it is indeterminate in *s* whether O is F. But there is a richer tapestry behind this claim. While it is not the case that O is F in *s*, it *is* the case that O is F in a *part* of *s*. Likewise, O is not F in a part of *s*. So it is both the case that O is F and that O is not F, but in different *parts* of *s*.[20] This means that *t* is the

of change from O's being not F to O's being F would not be *s* but a distinct situation *s**. The two distinct situations *s* and *s** would share all their proper parts and would differ intrinsically in their structuring of their parts. There is more to be said on this, but not here.

[18] An aside on the individuation of situations might be in order. As mentioned in the previous section, situations are like states of affairs and composed of entities, properties and relations. Situations are individuated by the entities in them, and by their having the properties they do and standing in the relations they do. Thus two situation which have different things the case in them are thereby distinct. This allows me to distinguish *s1* and *s2* even though they obtain at the same time (and, indeed, space).It also deals with the following potential problem: supposed O changes from F to not F and from G to not G at exactly the same time *t*. We might be worried that O's changing from F to not F can't be distinguished from a putative change from F to not G. But given that situations are individuated by their entities, there are distinct sub-situations where O is not F and where O is not G. It is only the former of these that is incompatible with the situation in which O is F, and hence it is only the combination of these two which gives us a change. Thanks to a reviewer for raising this interesting case.

[19] Notice that a Russellian might try to make the same sort of move, using situations to fine-grain one of the standard B-theory accounts of change. To take the temporal parts view as an example, it could be said that there are *two* parts of an object at the time O changes, such that one of O's parts is F and the other is not. These parts would be *situational* parts rather than temporal parts. This would allow for single, atomic time of change which is intrinsically distinguished on the Russellian account. The challenge would be motivating a relativisation of objects (or properties, or instantiation) to situations. I'll leave this possibility aside from here on.

[20] This has some echoes of the notion of 'plerosis' in Brentano, whereby a single instant can be a boundary both for the beginning of something's motion and the end of its rest (or *vice versa*). This is also applied to beginning and ceasing to exist. See discussion in Chisholm (1980) and Strobach (1998) pt. 2 ch. 2. Brentato's picture (at least as reconstructed by Chisholm) is importantly different from the one proposed here, however. According to Brentano, a single instant can be the time at which something begins to move and

temporal location of both the last situation in which O is F and the first situation in which O is not F. But the largest situation of what's going on at *t* is one in which O's F-ness is indeterminate.

The account I've offered here is one way to develop a view on which a changing object is neither in the pre-change state nor in the post-change state at the time at which it changes. It is also an account on which the time of change is a single, minimal time (and, if we allow moments of time, this will be a single moment of change). Of course, there could be other ways to spell out such a view. But I hope it is beneficial to show at least one concrete instance of a metaphysics of change that offers such an account of the time of change. In the next couple of sections, I will evaluate this view, by considering potential difficulties and some advantages to this conception of the time of change.

2.3 Some challenges

I will consider two potential objections to the view, albeit briefly. The first that while reality containing incompatible parts is bad enough, containing incompatible parts *at the same time* is too much to swallow. The second is that the situationalist approach seems to require true contradictions after all, and hence isn't very different from the normal dialetheist approach.

Situationalism is a metaphysical view with costs. I am not going to try to defend this general picture here. But it might seem that an application of the view to times of change makes these costs more problematic. Not only does reality contain disagreeing parts, but (on the view expressed in the last section) these parts are at exactly the same time. Can a situation corresponding to an atomic time be mereologically complex in the relevant sense? It might seem that there should be just one situation per time for any object's having a property.

In response, it might be helpful to look to an application of situationalism in a different context: quantum mechanics. I have argued (with a co-author) that something like the approach I articulate for change can be applied to the putative indeterminacy that arises in some interpretations of quantum mechanics (Darby and Pickup 2021). Supressing very many important details, one of the features of the situationalist account was that, when a quantum system is in a superposition of two incompatible states, the world has as parts *both* a situation in which it is in the first state *and* a situation in which it is in the second state. The important thing in this context is that these situations make incompatible claims about the state of a quantum system in one and the same portion of spacetime. So the broader situationalist picture and its applications already involve taking there to be disagreeing parts of reality which are at one and the same region of spacetime. It shows how situationalism might already make space for two contemporaneous situations disagreeing about how things are, and thereby giving rise to indeterminacy.

ceases to rest. But this is because the definitions of these concepts make them not incompatible ('the two phrases are not contraries' Chisholm 1980 p. 23). On the situationalist account, by contrast, there really is incompatibility between the pre- and post-change states. This is what gives rise to the indeterminacy which is a key feature of my account.

Of course, there are important differences between the quantum mechanical case and times of change. For instance, the non-separability/holism which appears a feature of certain quantum states is not present in times of change. Superposition can also be temporally extended, whereas a time of change is of minimal temporal duration. The situationalist has ways to reflect this difference in how they theorise about these cases.[21] So I am not claiming that superposition and times of change are the same kind of phenomena. Rather, (given some other assumptions) the situationalist can interpret both of these as involving metaphysical indeterminacy and, in particular, indeterminacy derived from disagreeing situations which are located in the same region of spacetime.

This might not be too reassuring, as quantum mechanics and the situationalist approach to it is hardly philosophically straightforward. But a recognition that situationalism already make space for co-located, disagreeing situations might make their use in this context seem less *ad hoc*.

The second worry was that situationalism seems committed to true contradictions after all.[22] If *s1* is at *t* and O is F in *s1*, then it appears that O is F at *t*. But *s2* is also at *t* and O is not F in *s2*, so it appears that O is not F at *t*. O being F and not F at *t* is a contradiction, so the ontology does give rise to contradictions after all.

The response to this challenge is to reiterate that what is the case (and what is true) is situation-relative. So, within the situationalist framework it isn't quite right to state that something is true at *t*. Something is true in some situation *at t*.

This is a bit cheap as it stands, however. While things are true in situations, there is indeed a situation corresponding to *t* as a whole, namely *s*. So the question can be rephrased as why, if *s1* and *s2* are parts of *s*, what is true in each of them isn't true together in *s*. In other words, why doesn't *s* contain a contradiction when its parts make true things which are contradictory?

The answer to this is the situationalist's denial of monotonicity, the principle that what is true in a part of a situation is true in the whole of that situation. Denying monotonicity is essential to the picture. But this denial is puzzling in the case of propositions like 'O is F'. How can adding extra parts to a situation make a difference to the truth of an atomic proposition like this, especially when it concerns an entity's intrinsic properties? The situationalist's denial of monotonicity is tied up with the radical claim that reality is disunified. Different portions of the world make incompatible claims about what intrinsic properties the entity has. These portions of the world are metaphysically on a par, and the claims are unrelativised. This is what leads to reality being split into individually coherent pieces, and to what's the case in reality as a whole being indeterminate. Reality is gappy, not glutty, and therefore doesn't make true any contradictions.

As I've said, this is a costly view. I do, however, take it to be an account which is a genuine alternative to a dialetheist approach.

[21] One option would be to employ a non-extensional mereology (see fn 17) so that a superposition situation is composed of its disagreeing parts in one way and a situation capturing a time of change is composed of its disagreeing parts in a different way. There's more to say here, but space constrains a full discussion. Thanks to Mike Hicks and a reviewer for comments here.

[22] Thanks to a reviewer for pushing me on this point.

2.4 Some advantages

Having set out the indeterministic account of times of change, undergirded by the broader situationalist picture of change, I wish to close by highlighting some potential positives features of the view. In keeping with my general approach, I will not be arguing that there is a decisive advantage to the indeterministic account. I have already indicated that there are costs to it, too. But I think there are some reasons to take it seriously as an alternative, especially if one is motivated by certain sorts of desiderata.

My proposed account offers an intrinsically distinguished, atomic time of change. It therefore gives a clear answer to the question of when a change occurs: at a single time. This avoids the difficulties faced by the view canvassed in Sect. 1.1 and the standard Russellian picture outlined in 1.2. It doesn't conflict with principles requiring a specific time for any event in time. It is also compatible a number of different topologies of time. It can be straightforwardly combined with time's being either continuous or discrete. It is clearly consistent with there being moments of time or times of minimal duration. But it could also be adapted to apply if time is finitely divisible without moments (as suggested in Sect. 1.1): in such a case the second model discussed there can be adopted (see p4).

So, it is clear when a change occurs on my proposal. The times of change are intrinsically distinguished, because they are the only atomic times where it is neither true nor false that the changing object is in the former state and neither true nor false that it is in the latter state. This avoids the charge of arbitrariness levelled against the variant of the Russellian view from 1.2. It also scratches a more inchoate itch that there's something *special* about the time something changes which is more than it just being the last or first moment of it being in a certain state. It validates the puzzlement that some have when encountering the question of what state a changing entity is in at the precise time it is *changing*.

Much as situationalism's general account of change is unusual in being a B-theory which upholds genuine incompatibility when things change, the application of the view to the time of change holds onto something typically given up by B-theorists. The time of change is special, on my view, in a way that the Russellian approach does not allow. A-theorists typically find B-theoretic accounts of change almost frustratingly unsatisfactory, as if the B-theorist is just not grasping what change is about. While the picture I'm presenting is B-theoretic, I think it is at least a little closer to warranting some A-theoretic intuitions. The time of change is when something important is happening: reality is conflicted at that point. The unified parts of reality have their edges at these times. To be clear, though, I don't think an A-theorist could be satisfied with the account: the dynamism that A-theory offers is not present here. But it does show that at least one B-theory can give a real sense in which times of change are importantly distinguished from other times.

As a final point in its favour, the approach I've offered does all this without admitting true contradictions. As I've argued above, situationalist treatment of the time of change doesn't entail any dialetheia: contradictory propositions are not true together in any situation. If puzzles concerning times of change are offered as a motivation for dialetheism, my alternative account is one line of defence.

It might be charged that this defence is a case of out of the frying pan and into the fire. I don't agree. Although I recognise that the metaphysics of situationalism is controversial and, in some aspects, revisionary, I think it is still substantially less dramatic than dialetheism. Rejecting bivalence or excluded middle is not as revisionary as rejecting non-contradiction. Taking reality to be disunified is not as controversial as taking it to be contradictory. So those who find the arguments against a Russellian account of the moment of time persuasive might find in my proposal a stopping point between that view and wholesale rejection of the law of non-contradiction.

3 Conclusion

In this paper I have tried to show one way to develop a certain view of the precise time at which an object changes. The alternative I've outlined is one according to which there is a single time at which a match changes from being unlit to being aflame. At this time, the time the match *alights*, it is neither unlit nor aflame.

I have introduced this alternative within the context of a broader theory of change: situationalism. The match being neither unlit nor aflame is a matter of its being metaphysically indeterminate what the state of the match is at the time it alights. There is a portion of the world at that time in which it is unlit. But there is also another portion of the world at the *same* time in which it is aflame. Change is a matter of these incompatible parts of reality both being real, and the time of change is the only atomic time where there are both such incompatible parts. Reality as a whole is not contradictory, however, because it is disunified. The differing fragments of reality are what create gappiness in how things are when they change.

Situationalism is a B-theory, and so the account of the time of change offered here is B-theoretic. It is perhaps surprising that a B-theory can identify an atomic time as an intrinsically special time of change. The fact that situationalism can offer satisfying answers to the difficult questions that arise about times of change adds to a cumulative case for taking the view seriously as an account of how the world is, despite the costs undoubtedly associated with doing so. Exploring this terrain also adds nuance to debates between A-theorists and B-theorists, as it shows that the standard, Russellian account of change is not the only one available for those who, like me, take all times to be metaphysically on a par.

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