**Are the Folk Functionalists About Time?**

Abstract

This paper empirically investigates the contention that the folk concept of time is a functional concept: a concept according to which time is whatever plays a certain functional role or roles. This hypothesis could explain why, in previous research, surprisingly large percentages of participants judge that there is time at worlds that contain no one-dimensional substructure of ordered instants. If it seems to participants that even in those worlds the relevant functional role is played, then this could explain why they judge that there is time in those worlds. While our experiment supported the finding that participants are reticent to judge that there is no time, actually, we found no evidence that this is because they deploy a functionalist concept, at least of the kind proposed in recent research. Our findings are, however, consistent with the folk deploying a much more minimal functionalist concept according to which time is just whatever it is—regardless of its nature—that plays the role of grounding our temporal phenomenology.

1. Introduction

There has been a recent surge in interest in the folk concept (or representation, or naïve theory of) of time, arising, in part, from a desire to know whether recent so-called timeless physical theories (see for instance (Barbour 1999, 1994b, 1994a; Anderson 2006; Deutsch 1997; Rovelli 1995; 2007; 2004) are timeless in the folk sense that is relevant to deliberation, agency, and related notions (see Baron and Miller 2015a; 2015b; Tallant 2018).

It seems clear that on many views about the content of *the* (assuming for now that there is a single shared) folk concept, at least some such theories[[1]](#footnote-1) will indeed be folk-timeless, i.e. will not be worlds that satisfy our folk concept of time. That is because according to some of these timeless physical theories there is no one-dimensional substructure of ordered temporal *instants*, where an instant is a three-dimensional object in which all the particles in the universe are arranged in a Euclidean 3-space (if you like, it is a snapshot of our universe at a moment in time, except that there being such instants does not presuppose that there is time). On such views there is no temporal metric, and thus no distance relations between these instants. There is substantial disagreement, in the philosophy of time as to what metaphysical structure is essential to there being time—an A-series,[[2]](#footnote-2) a B-series,[[3]](#footnote-3) or merely a C-series.[[4]](#footnote-4) Corresponding to this disagreement, it’s plausible to hold that there are, roughly, three views about the folk concept of time: that it is a concept on which an A-series is necessary for the there to be time; that it is a concept on which a B-series is necessary for there to be time; and that is a concept on which the C-series is necessary for there to be time (see Baron and Miller 2015a). On any of these views regarding the nature of our concept, however, timeless physical theories of this kind are indeed folk timeless.

More recently, however, it has been suggested that our folk concept of time might be a functionalist concept: a concept according to which what time is, is whatever plays a certain functional role. That, of course, leaves it entirely open what nature the thing has, which plays that role. Hence it leaves it open that such a concept might be satisfied even if our world turns out to be correctly described by a timeless physical theory. After all, it might be that even in worlds correctly described by a timeless physical theory, *something* nevertheless plays whatever the relevant role is taken to be.

This paper empirically investigates the idea that our folk concept of time is a functionalist concept. We begin in §2 by outlining recent functionalist accounts and describing some recent research into the folk concept of time. In §3 we describe our methodology and results. In §4 we consider these results, and their implications for evaluating whether or not timeless physical theories are folk timeless.

**2. The literature**

In what follows we suppose that concepts are contentful constituents of thoughts, and that a concept of time is a mental state which guides (and perhaps is also constituted by) people’s dispositions to make judgements about whether some world, (actual or counterfactual), contains time. We don’t assume that concepts must be explicit, so we allow that the individuals who employ those concepts may not be able clearly to articulate their contents, let alone provide anything like necessary and sufficient conditions for something to satisfy those concepts. That is why in our experiments we ask people to use their concepts, rather than describe their content.

Nevertheless, in so doing we assume that people’s behaviour—linguistic and otherwise—provides evidence for the content of even tacit concepts. In particular, we assume that what individuals say, across a range of scenarios we describe, regarding whether there is time in that scenario, is defeasible evidence regarding certain aspects of the content of their concept.

Further, in what follows we will talk of ‘our’ folk concept of time. But we do not assume that there is a single, shared, concept of time amongst all people. Given that the various ways people represent the time-line and represent past and future through linguistic metaphor, gesture and written diagram, varies across cultures (See Evans, 2003, 14; Sinha and Gardenfors 2014; Boroditsky, Fuhrman, McCormick 2010; Fuhrman, McCormick, Chen, Jiang, Shu, Mao, & Boroditsky 2011; Chen 2007; Boroditsky 2001; Casasanto & Bottini, 2014) it may well be that the concept of time varies cross culturally. Indeed, it is not even clear that there is a single, shared, concept amongst people of roughly a Western background (see Latham, Miller and Norton 2019).

Our sample population is drawn exclusively from the US, and we make no claims regarding whether our results generalise to other populations. Nor do we assume that we will find a single shared concept amongst this population: though for now, we continue to talk of ‘the’ and ‘our’ folk concept.

Further, while we are concerned to probe whether or not the folk concept of time is a functionalist one, at best we can investigate certain views put forth in the literature. Any conclusions we draw will only be conclusions about whether our participants’ concept of time is the kind of functionalist concept upon which we focus. Still, we think that the theory we focus on is a good contender to be the most plausible for the functionalist accounts, so if the folk turn out not to have a functionalist concept that is like that one, that will be an important discovery.

Baron and Miller (2015a; 2015b) first suggested that the folk concept of time is a functionalist concept. In what follows we take a functionalist concept to be a concept that is satisfied at any world iff there is something in that world that plays some particular functional role. So consider the concept <bachelor>[[5]](#footnote-5). <Bachelor> is not a functional concept: instead, it’s a concept that is satisfied at any world just in case there is something that meets particular criteria: being an unmarried man. It would be a functional concept if for instance, it were satisfied in any world by whatever plays some functional role: say, the role of being an attractive marriage partner. The difference between <bachelor> as we know it, and <bachelor> the functional concept, is that while on the latter view anything whatsoever can be a bachelor as long it plays the role of being an attractive marriage partner, on the former (familiar) view something can play the role of being an attractive marriage partner and not be a bachelor (by being a woman), and something can be a bachelor even if it fails to play the role of being an attractive marriage partner (by being an monstrous psychopathic unmarried man).

So, the claim that time is a functional concept is the claim that something is time, in any world, just in case it plays some functional role R, where it is up for grabs what role R is. This allows that what it is that plays that role might vary between worlds. For instance, it could be that the presence of a B-series in fact plays role R, but in other worlds the presence of an A-series plays that role. It could be that even though in fact most people think that our world contains an A-series (see Latham, Miller and Norton 2019), they will agree that there is time in our world even if it only contains a C-series, and they will do so because the C-series plays the relevant functional role.

Functionalist views of the concept of time differ from most contemporary views of the nature of that concept, which tend to assume either that our concept is A-theoretic (it is satisfied at a world iff that world contains an A-series[[6]](#footnote-6)) or our concept is B-theoretic (it is satisfied at a world iff that world contains a B-series[[7]](#footnote-7)) and so on for other suggestions about what metaphysical structure is necessary and sufficient for our concept of time to be satisfied.

Baron and Miller suggest that rather than supposing that there are certain application conditions for <time> that appeal to the presence of a metaphysical structure, instead the concept might be one on which time is just *whatever it is that underlies certain experiences, or phenomena, in our world*. In particular, they suggest that for the folk, time is the thing that is responsible for our world seeming like *this*, where it’s seeming like this is, roughly, its seeming to contain events that are ordered, with distance relations between them; its seeming to contain objects that persist; its seeming to contain events that are causally connected, where events earlier in the ordering cause those later in the ordering; its seeming as though we remember events that are in the past, but not the future; its seeming that we deliberate about events that are in the future, but not the past. Let’s call this *a temporal seeming.* Baron and Miller reason that if this is right, the folk concept is a functional one: time is just whatever it is that plays a certain functional role: roughly speaking, the role of grounding there being a temporal seeming (2015a). In what follows we will talk about what our temporal seemings *track*, where we suppose that our temporal seemings track some phenomenon P, just case P grounds our having the temporal seemings that we do.

Now, Baron and Miller argue that this cannot be quite right. If it turns out that a demon is responsible for the temporal appearances, Baron and Miller think that the folk will deny that the demon is time. For demons are fundamentally unlike what we take our temporal phenomenology to be tracking. In light of this, they argue that a functional analysis of time must include some additional constraint, so that it is not the case that *whatever* is responsible for the temporal seemings is time, regardless of what thing is like. In particular, it ought not be that time is *fundamentally unlike* what we suppose our temporal phenomenology to be tracking.

Importantly, by this they do not mean that the thing we are tracking with our temporal phenomenology must be *metaphysically* like we imagined it to be. Indeed, Baron and Miller are drawn to functionalist views because they think it likely that people would be disinclined to conclude that actually, there is no time, were they to make a whole range of discoveries about the underlying metaphysics of the actual world. They find it plausible that even if people *in fact* suppose that our world contains an A-series,[[8]](#footnote-8) they will still judge that our world contains time if they come to discover that really there is only a B-series and no A-series. They also find it plausible that people who think there is in fact a B-series, will nevertheless still judge there to be time if they discover there is only a C-series. In general, they argue, there are many discoveries we could make about the underlying metaphysics of our world, all of which are discoveries on which there is still actually time (even if time turns out to be somewhat different than we expected).

Recent evidence from experimental philosophy suggests that they are right about this. Latham, Miller, and Norton (2020) found that amongst participants who think that actually, there is an A-series, most still conclude that there is actually time, when told that it turns out in fact there is only a B-series and no A-series. Latham and Miller (2020) found that when presented with vignettes describing a counterfactual one-instant world (a world that contains a single instant of time, or, if you prefer, a single three-dimensional slice of reality) a surprising ~50% of participants held that there was time in such a world.

Baron and Miller only intend to deny that something is time when it is plays the role of grounding our temporal seemings, if what plays that role is fundamentally different from how we take time to be. In turn, they think that something that plays that role would be fundamentally different for how we take it to be, if it were not the kind of thing that is necessary for the existence of causation, persistence, and change. (2015(a): 2435).

One way to think about this proposal is as a kind of constrained functionalist account, on which time is whatever plays the role of grounding our temporal seemings, as long as it has features necessary for the existence of causation, persistence, and change. A slightly different way to think about the view is as one which there are really two roles at issue: grounding our temporal seemings and grounding causation, persistence, and change. The latter version of the view is somewhat weaker, insofar as something could in fact ground causation, persistence, and change, and yet not be *necessary* for their existence. For present purposes, though, we think that little hangs on this difference, and it is this latter view that we operationalize in our study. Hence, conceived in this way it is a view on which time is just whatever it is that plays *two* roles: the role of grounding our temporal seemings, and the role of grounding causation, persistence, and change. In our study we simplify this latter functional role and focus only on causation and change.

Thus, we can distinguish two functionalist views. The first of these is the one that (roughly speaking) Baron and Miller defend. We call this Dual Role Functionalism.

**Dual Role Functionalism**: Time is whatever it is that plays *both* the role of grounding our temporal seemings and the role of grounding causation and change.

A much weaker version of functionalism is what we call Seeming Role Functionalism. It is the following view:

**Seeming Role Functionalism:** Time is whatever it is that plays the role of grounding our temporal seemings.

Recall, Baron and Miller think that Seeming Role Functionalism is false because they predict people will not conclude that if a demon plays the role of grounding our temporal seemings, then the demon is time.

We empirically investigate Dual Role Functionalism, though we return to Seeming Role Functionalism in our discussion. In order to investigate Dual Role Functionalism there are three kinds of evidence about people’s judgments that we need. First, we need to know what judgments people have about whether there is time, if what our temporal seemings track is also what plays the role of grounding causation and change, (the tracking condition) and conversely, if what plays the former role does not also play the latter (the non-tracking condition). That is because if Dual Role Functionalism is true, we will only judge that there is time in the tracking condition, and not in the non-tracking condition. Our first hypothesis captures this.

H1: People, overall, will judge that there is no time if our temporal phenomenology (i.e. our temporal seemings) is not tracking what is responsible for causation and change. (Conversely, people, overall, will judge that there is time if our temporal phenomenology is tracking what is responsible for causation and change.)

As we noted earlier, Dual Role Functionalists do not think that we will judge there to be no time if it should turn out that our temporal phenomenology is tracking something with a metaphysical structure somewhat unlike what we expected. For they think that anything at all, metaphysically speaking, can be time, as long as that thing plays the two roles in question. So the second piece of evidence we want to collect, is people’s judgements about whether there is time when our temporal phenomenology is tracking is something that is either metaphysically similar, or dissimilar, from what we were expecting it to track. Given previous evidence on this matter arising from Latham, Miller, and Norton (2019) we took a metaphysical structure to be similar to the one we would expect if it is a growing block structure, and dissimilar if it is mere C-series ordering of events. So, the Dual Role Functionalist then makes the following second prediction.

H2: People, overall, will continue to judge that there is time even if our temporal phenomenology is tracking something that is dissimilar to what they expected it to track, so long as what is being tracked is responsible for causation and change.

Finally, since the Dual Role Functionalist thinks that time is just whatever it is that our temporal phenomenology tracks (and which also grounds causation and change) we also want to gather evidence about whether people will judge that there is time if there is *nothing* in the world to track with our temporal phenomenology. The Dual Role Functionalist thinks we will judge that in that circumstance there is no time. So, she makes the following final prediction:

H3: People, overall, will judge that there is no time if our temporal phenomenology is not tracking what is responsible for causation and change, and in addition, there is nothing to track.

In what follows we empirically investigate these three hypotheses.

In order to do so we use several base vignettes that describe a *counterfactual* world, rather than the actual world. We introduce these counterfactual worlds in order to draw attention to the ways in which temporal phenomenology can track, or fail to track, what is responsible for causation and change, and to draw attention to the ways in which our temporal phenomenology can track something that is metaphysically similar to, or dissimilar to, what we expect it to track. After having seen the counterfactual vignette we then tell participants that the actual world is like, or unlike, the counterfactual world in certain ways, and ask them to evaluate claims about whether there is time in the actual world.

**3. Experimental Design and Results**

**3.1 Experiment Method**

*3.1.1 Participants*

584 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated $0.50 for approximately 5 minutes of their time. To participate, participants were required to have previously completed at least 1000 tasks on Amazon Mechanical Turk with a 95% task approval rating.[[9]](#footnote-9) 79 participants had to be excluded for failing to follow task instructions. This means that they failed to answer the questions (77), or failed an attentional check question (2). The remaining sample was composed of 505 participants (aged 18-95; (209 female; 3 prefer not to answer). Mean age 37.52 (SD = 12.40). Ethics approval for this study was obtained from the [blanked] Human Research Ethics Committee. Informed consent was obtained from all participants prior to testing. The survey was conducted online using Qualtrics.

*3.1.2 Materials and Procedure*

Participants were randomly assigned to one of five conditions: Condition 1 [counterfactual tracking, actual tracking, similar] condition 2 [counterfactual tracking, actual non-tracking; similar] condition 3 [counterfactual tracking, actual tracking, dissimilar] condition 4 [counterfactual tracking, actual non-tracking, dissimilar] condition 5 [counterfactual non-tracking, actual non-tracking]. In each condition, participants read a single vignette and respond to a single set of statements. Each base vignette describes a counterfactual world. There are three base vignettes. At the end of each of the base vignettes participants are either told that the actual universe is just like the universe described, or that the actual universe is different in certain ways from the universe described. These variations to the base vignette result in there being five distinct total vignettes seen by participants. These are below:

**Base Vignette: Counterfactual Tracking; Similar**

Imagine that in universe A/C it seems to agents like us as though events happen in a certain order—that breakfast comes before lunch—and that events have a certain duration—that the concert lasts an hour. It seems as though events are separated by some distance—that breakfast occurred two hours before the concert. It also seems as though we can, and ought to, deliberate about what to do about future events, but not past events. Each of us can wonder what we ought to eat for breakfast tomorrow, but we don’t wonder what we ought to eat for breakfast yesterday. It seems as though what we do today can affect how things are tomorrow, but not how they were yesterday. It seems as though we are moving into the future, as future events come ever closer to us, become present, and then recede into the past. In universe A/C scientists call all these ways things seem to agents, their *temporal phenomenology.* Some scientists, philosophers and theologians in universe A think that whatever time is, it is the thing in the world that is responsible for agents like us having this temporal phenomenology.

In universe A/C, new events and objects constantly come into existence. The events and objects that come into existence remain in existence, so the sum total of reality grows as new events and objects come to exist. In this universe we can generate an ordering of events in terms of the coming into existence of new events and objects. Some scientists, philosophers and theologians in Universe A/C think that the set of events and objects that have just come into existence are those that are in the present. They think that as new events and objects come into existence, already existing events and objects become part of the past. They think that no future events and objects exist.

For example, in Universe A/C there are two particles, P1 and P2. In this universe, there is an event of P1 hitting a particle detector, and an event of P2 hitting that particle detector. When the event of P1 hitting the detector has just come into existence, the event of P2 hitting the detector does not exist; but when the event of P2 hitting the detector has just come into existence, the event of P1 hitting the detector exists.

So some scientists and philosophers in this universe think that when P1’s hitting the detector has just come into existence, P2’s hitting the detector is future and does not exist, and when P2’s hitting the detector has just come into existence, P1’s hitting the detector exists, and is past. In this universe the ordering of events that is generated via the coming into existence of new events and objects has a single, correct, direction. In this case, it goes *from* P1’s hitting the detector, *to* P2’s hitting the detector (not from P2’s hitting the detector to P1’s hitting the detector).

In universe A/C, causation is the coming into existence of new events. This is also responsible for change in universe A/C.

As it turns out, the reason agents like us in universe A/C have the temporal phenomenology they do, is because universe A/C is as just described: it is because new events come into existence, in a certain order, and then remain in existence.

After seeing this vignette, those in the actual tracking condition (who read the above as universe A) saw the following:

**Actual Tracking Condition**

As it turns out, scientists have discovered that universe A is just like our universe in all respects. Our temporal phenomenology is just like that of agents like us in universe A, and the reason we have the temporal phenomenology we do, is just the same as the reason why the agents in Universe A have the temporal phenomenology they do.

Participants then read the following statements and respond to (a) and (b) on a Likert scale of 1 (completely disagree) to 7 (completely agree). After making each response, participants responded to (c) on a Likert scale of 1 (completely unconfident) to 2 (completely confident). In every condition the orientation of the Likert scale was randomized.

1. There is time in universe A.
2. There is time in our universe.
3. Please indicate your level of confidence in your judgement.

Those who were in the actual non-tracking condition (who read the vignette as referring to universe C) saw the following:

**Actual Non-tracking Condition**

As it turns out, scientists have discovered that universe C is just like our universe in almost all respects. The only difference between our two universes is that our temporal phenomenology is not caused in the same way as the temporal phenomenology of the agents in universe C. So the reason we have the temporal phenomenology we do, is **not** the same as the reason why the agents in Universe C have the temporal phenomenology they do. Instead, we have the temporal phenomenology we do, because an evil demon directly creates these experiences in us. The reason it seems to us that events happen in a particular order is because the demon creates experiences in which this seems to be the case. The reason it seems to us as though events have a certain duration, is because the demon creates experiences in which this seems to be the case. The evil demon is responsible for all of us having the temporal phenomenology we do.

Participants then saw the following statements and responded to them on 7-point Likert scale.

1. There is time in universe C.
2. There is time in our universe.
3. Please indicate your level of confidence in your judgement.

**Base Vignette: Counterfactual Tracking; Dissimilar**

Imagine that in universe B/D it seems to agents like us as though events happen in a certain order—that breakfast comes before lunch—and that events have a certain duration—that the concert lasts an hour. It seems as though events are separated by some distance—that breakfast occurred two hours before the concert. It also seems as though we can, and ought to, deliberate about what to do about future events, but not past events. Each of us can wonder what we ought to eat for breakfast tomorrow, but we don’t wonder what we ought to eat for breakfast yesterday. It seems as though what we do today can affect how things are tomorrow, but not how they were yesterday. It seems as though we are moving into the future, as future events come ever closer to us, become present, and then recede into the past. In universe B/D scientists call all these ways things seem to agents, their *temporal phenomenology.* Some scientists, philosophers and theologians in universe B/D think that whatever time is, it is the thing in the world that is responsible for agents like us having this temporal phenomenology.

Imagine that in universe B/D a single set of events exists. All these events are equally real. The sum total of reality never grows or shrinks, so the totality of events that exist never changes. These events bear certain relations to one another and these relations between events in our universe are fixed and never change. It is possible to order the events in that universe in terms of these relations. Some scientists, philosophers and theologians in universe B/D call these relations of betweenness. In universe B/D no set of events is special, in that every event is present from the perspective of those located at it, just as every location is ‘here’ from the perspective of those located at it.

For example, in universe B/D there are three particles, P1, P2, and P3. In this universe, there is an event of P1 hitting a particle detector, and an event of P2 hitting that particle detector, and an event of P3 being deflected from the particle detector. The event of P1 hitting the particle detector is *between* the event of P3 being deflected from the particle detector, and the event of P2 hitting the particle detector. That relation never alters; it is always the case that the event of P1 hitting the particle detector is between the events of P2 hitting the detector, and P3 being deflected from the detector. In universe B the ordering of events generated by the betweenness relations does not generate a direction: there is no fact of the matter as to whether the ordering goes from P3’s being deflected from the detector, *to* P1’s hitting the detector *to* P2’s hitting the detector or, alternatively, *from* P2’s hitting the detector *to* P1’s hitting the detector, *to* P3’s being deflected from the detector. Instead, in universe B, from one perspective, P3’s being deflected from the detector occurs earlier than P1’s hitting the detector which occurs earlier than P2’s hitting the detector, and that from another perspective P2’s hitting the detector occurs earlier than P1’s hitting the detector, which occurs earlier than P3’s being deflected from the detector.

In universe B/D, one event causes another when the two events are ‘glued together’ in the universe. But which of the events is the cause, and which is the effect, is a matter of perspective. For some agents, it will seem as though one of the events is the cause, and the other the effect, and for others, located at very different locations in the universe, the reverse will seem to be the case. In this universe there is change, because an object at one time, is caused to exist at some other time, and that object is different at different times.

As it turns out, the reason agents like us in universe B/D have the temporal phenomenology they do, is because events are ordered in the way they are, with certain distance relations between them, and because from certain perspectives within the universe, causation seems to occur in particular direction.

Participants in the actual tracking condition then saw the following:

**Actual Tracking Condition**

As it turns out, scientists have discovered that universe B is just like our universe in all respects. Our temporal phenomenology is just like that of agents like us in universe B, and the reason we have the temporal phenomenology we do, is just the same as the reason why the agents in Universe B have the temporal phenomenology they do.

Participants then respond to the following statements using the 7-point Likert scale.

1. There is time in universe B.
2. There is time in our universe.
3. Please indicate your level of confidence in your judgement.

Participants in the actual non-tracking condition saw the following:

**Actual Non-Tracking Condition**

As it turns out, scientists have discovered that universe D is just like our universe in almost all respects. The only difference between our two universes is that our temporal phenomenology is not caused in the same way as the temporal phenomenology of the agents in universe D. So the reason we have the temporal phenomenology we do, is **not** the same as the reason why the agents in Universe D have the temporal phenomenology they do. Instead, we have the temporal phenomenology we do, because an evil demon directly creates these experiences in us. The reason it seems to us that events happen in a particular order is because the demon creates experiences in which this seems to be the case. The reason it seems to us as though events have a certain duration, is because the demon creates experiences in which this seems to be the case. The evil demon is responsible for all of us having the temporal phenomenology we do.

Participants then responded to the following statements using a 7-point Likert scale.

1. There is time in universe D.
2. There is time in our universe.
3. Please indicate your level of confidence in your judgement.

So, a counterfactual world with tracking (counterfactual tracking) can be one in which the temporal phenomenology of the counterfactual individuals is tracking something *similar* to what people in fact think their own phenomenology is tracking (the accretion of a growing block world; counterfactual tracking, similar). This is base vignette 1. If participants are subsequently told that the actual world is one in which there is tracking (actual tracking), then it follows that actual phenomenology is tracking whatever the counterfactual individuals are tracking. Such participants are in the counterfactual tracking, actual tracking, similar, condition. Alternatively, participants may instead be told that people’s actual phenomenology is *failing* to track whatever the counterfactual individuals are tracking. Then they are in the counterfactual tracking, actual non-tracking, similar, condition.

A counterfactual world with tracking may instead be one in which the temporal phenomenology of the counterfactual individuals is tracking something *dissimilar* to what people in fact think their own phenomenology is tracking (a C-series; counterfactual tracking, dissimilar). This is base vignette 2. Some participants in this condition are told that the actual world is one in which people’s phenomenology is tracking whatever the counterfactual individuals are tracking (counterfactual tracking, actual tracking, dissimilar). Other participants are told that people’s actual phenomenology is failing to track whatever the counterfactual individuals are tracking (counterfactual tracking, actual non-tracking, dissimilar).

Finally, the base vignette (3) may be one in which there is no counterfactual tracking (counterfactual non-tracking) i.e. people’s phenomenology in the counterfactual world fails to track what is responsible for causation and change because there is nothing in that world that is responsible for causation and change. In this condition participants are told that the actual world is just like this, and so in the actual world people’s phenomenology fails to track what is responsible for causation and change since there is nothing in the actual world that is responsible for causation and change (counterfactual non-tracking, actual non-tracking).

**Base Vignette: Counterfactual Non-tracking; Actual Non-tracking**

Imagine that in universe E it seems to agents like us as though events happen in a certain order—that breakfast comes before lunch—and that events have a certain duration—that the concert lasts an hour. It seems as though events are separated by some distance—that breakfast occurred two hours before the concert. It also seems as though we can, and ought to, deliberate about what to do about future events, but not past events. Each of us can wonder what we ought to eat for breakfast tomorrow, but we don’t wonder what we ought to eat for breakfast yesterday. It seems as though what we do today can affect how things are tomorrow, but not how they were yesterday. It seems as though we are moving into the future, as future events come ever closer to us, become present, and then recede into the past. In universe E scientists call all these ways things seem to agents, their *temporal phenomenology.* Some scientists, philosophers and theologians in universe E think that whatever time is, it is the thing in the world that is responsible for agents like us having this temporal phenomenology.

In universe E, a single set of events exists. All these events are equally real. The sum total of reality never grows or shrinks, so the totality of events that exist never changes. While all these events exist there is no correct way to order these events. Instead, Universe E is like a deck of cards. Each card represents all the events that bear purely spatial relations to one another. Purely spatial relations are relations such as Mike being three feet from Lily, or Boston being 16000kms from Sydney. In universe E, the only distance relations that exist are spatial distance relations. So each ‘card’ represents all the events that are spatially separated from one another, and which bear no other distance relations to one another. Some scientists, philosophers, and theologians in universe E are inclined to say that all the events ‘on the same card’ occur simultaneously. While there is a fact of the matter regarding the spatial relations between objects and events located on the same card, there is no fact of the matter as to the order of the cards. Any way of ordering the cards is just as good as any other way. Because of this, there is no fact of the matter about the distance relations between events on different cards.

In universe E there are three particles, P1, P2 and P3. In this universe, there is an event of P1 hitting a particle detector, an event of P2 hitting that particle detector, and an event of P3 being deflected by that particle detector. The event of P1 hitting the detector and the event of P3 being deflected from the detector bear spatial relations to each other. So there is a fact of the matter as to spatial distance between P1’s hitting the detector and P3’s being deflected by the detector. So we can say how far away P1 is, from P3, when each encounters the detector. As some scientists in universe E would have it, these two events occur simultaneously. But the event of P2 hitting the detector does not occur simultaneously with either P1 hitting the detector or P3 being deflected by the detector. P2’s hitting the detector is, as it were, on a different card from P1’s hitting the detector and P3’s being deflected by the detector. So there is no fact of the matter regarding the distance between P1’s hitting the detector and P2’s hitting the detector, or between P3’s being deflected by the detector and P2’s hitting the detector. Nor is there any fact of the matter which order these events occur in. It is no more true to say that first P3 is deflected from the detector, and second, P2 hits the detector, than it is to say that first P2 hits the detector, and second, P3 is deflected by the detector. And that is true for all events in universe E that are not simultaneous with one another. Any way of ordering non-simultaneous events is equally good.

So while in universe E it seems to agents like us as though the universe progresses through a series of changes in which the ways it was at an earlier time, affects how it is at a latter time, this is an illusion. In universe E, there is no causation and there is no change. The reason agents like us in universe E have the temporal phenomenology they do, is because many of the ‘cards’ in that universe contain *apparent* records of past times, such as the existence of apparent tree rings, and apparent fossils, and apparent books, and apparent historical documents. Amongst these apparent records are the apparent memories of each of those agents. They *seem* to remember their universe being some different way at an earlier time; they *seem* to remember deciding what to eat yesterday, and they *seem* to remember deliberating about what to eat today. They not only *seem* to remember past events, but they *seem* to remember remembering past events. All these apparent memories are the result of a single three-dimensional configuration of their brains. None of these memories are real. Even if there events just like these on other ‘cards’, those events do not cause these memories. It is the totality of these apparent memories that explains why they have the temporal phenomenology they do.

Participants then saw the following:

As it turns out, scientists have discovered that universe E is just like our universe in all respects. Our temporal phenomenology is just like that of agents like us in universe E, and the reason we have the temporal phenomenology we do, is just the same as the reason why the agents in Universe E have the temporal phenomenology they do.

Participants then responded to the follow statements using a 7-point Likert scale.

1. There is time in universe E.
2. There is time in our universe.
3. Please indicate your level of confidence in your judgement.

*3.3 Analyses*

Before reporting the specific test-statistics and details, let’s begin with a summary of our main findings. We had three main hypotheses. First, that people, overall, will judge that there is no time actually, if actual temporal phenomenology is not tracking what is responsible for causation and change. Second, that people, overall, will judge that there *is* time actually, even if actual temporal phenomenology is tracking something that is dissimilar to what they expected it to track, *so long as what is being tracked is responsible for causation and change*. Finally, that people, overall, will think that there is *no* time in the actual world, if not only are we not tracking what is responsible for causation and change, but, in addition, there is nothing to track.

However, contrary to our predictions the vast majority of participants across *all* the conditions we tested judged that there was time in the actual world and, indeed, in the counterfactual world described.

Table 1 and Table 2 summarizes the descriptive data from the experiment. The ‘Yes’ column shows the proportion of participant’s who responded with either a 5, 6, or 7 when asked their level of agreement to either the statement: ‘there is time in universe A/B/C/D/E’ (Table 1), or ‘there is time in our universe’ (Table 2). The ‘No’ column is the proportion of participant’s who responded with either 1, 2, or 3, when asked their level of agreement to those same statements. The ‘4’ column is the proportion of people who neither agree nor disagree with either of those statements. Overall people were confident in their judgments about the world described (M = 5.27, SD = 1.53) and the actual world (M = 5.75, SD = 1.38). There were no significant differences between people’s confidence in their judgments across conditions.

While Table 1 and Table 2 makes it clear that most participants thought there was time both in the world described and the actual world in all conditions, this was confirmed by running multiple one-sample t-tests against ‘4’. The results of all these tests are also shown in Table 1 and Table 2 and confirm that, overall, people judged that there was time in the world described and actual world in all the conditions.

*Table 1.* *Levels of agreement* *to the statement ‘there is time in universe A/B/C/D/E’*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **%Yes** | **%No** | **%4** | **Mean** | **SD** | ***t-test*** | ***p*-value** |
| **Condition 1:** Counterfactual Tracking,  Actual Tracking, Similar (N =105) | 90.5 | 5.7 | 3.8 | 5.81 | 1.22 | 15.228 | <.001 |
| **Condition 2** Counterfactual Tracking, Actual Non-Tracking, Similar (N = 105) | 82.9 | 11.4 | 5.7 | 5.64 | 1.37 | 12.282 | <.001 |
| **Condition 3** Counterfactual Tracking,  Actual Tracking, Dissimilar (N = 102) | 89.2 | 8.8 | 2 | 5.72 | 1.36 | 12.743 | <.001 |
| **Condition 4:** Counterfactual Tracking  Actual Non-Tracking, Dissimilar (N = 96) | 84.4 | 13.5 | 2.1 | 5.47 | 1.47 | 9.823 | <.001 |
| **Condition 5** Counterfactual Non-Tracking, Actual Non-Tracking (N = 97) | 77.3 | 17.5 | 5.2 | 5.16 | 1.66 | 6.901 | <.001 |

*Table 2. Levels of agreement to the statement ‘there is time in our universe’.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **%Yes** | **%No** | **%4** | **Mean** | **SD** | ***t-test*** | ***p*-value** |
| **Condition 1**: Counterfactual Tracking,  Actual Tracking, Similar (N =105) | 91.4 | 2.9 | 5.7 | 6.01 | 1.11 | 18.490 | <.001 |
| **Condition 2:** Counterfactual Tracking, Actual Non-Tracking, Similar (N = 105) | 81.9 | 10.5 | 7.6 | 5.82 | 1.52 | 12.281 | <.001 |
| **Condition 3:** Counterfactual Tracking,  Actual Tracking, Dissimilar (N = 102) | 95.1 | 2.0 | 2.9 | 6.28 | 0.99 | 23.331 | <.001 |
| **Condition 4:** Counterfactual Tracking  Actual Non-Tracking, Dissimilar (N = 96) | 87.4 | 6.3 | 6.3 | 5.82 | 1.31 | 13.678 | <.001 |
| **Condition 5**: Counterfactual Non-Tracking, Actual Non-Tracking (N = 97) | 86.6 | 8.2 | 5.2 | 5.80 | 1.37 | 12.930 | <.001 |

While our primary interest in this paper is people’s judgments about *our* world, we also asked people’s judgments about the counterfactual world described. That’s because we wanted to control for the fact that some people might just say there is actually time regardless of how they are told things are actually discovered to be. That’s because they might fail to take seriously that the scenario being described as actual is actual, and simply respond as though they are assessing whether there is actually time given the way they in fact suppose our world to be.

Condition 1 and Condition 3 in our experiment describe counterfactual worlds that participants are told are just like the actual world in all respects. So, if there are much higher levels of agreement that there is time in the actual world than in these counterfactual worlds, that would suggest that people were not really taking seriously that the actual world has been discovered to be the way the vignette says it has.

To test this, we ran separate paired-sample t-tests to compare each participant’s responses to the statement about the counterfactual world and their responses to the statement about the actual world in Condition 1 and Condition 3. The results of these tests showed that people’s levels of agreement was significantly higher when they were asked about the actual world than the counterfactual world, both in Condition 1, *t*(104) = 2.297, *p* = .024, and Condition 3, *t*(101) = 4.466, *p* < .001. However, as, Table 1 and Table 2 make clear, the overall differences between people’s judgments about the actual world and counterfactual world in these conditions is very small, and roughly what you might expect (since one would expect people to be more confident in their judgements about scenarios considered as actual than they would scenarios considered as counterfactual).

Finally, despite people, overall, agreeing that there is time both in the actual world and counterfactual world across all five conditions, we were interested in testing whether there were any significant differences between levels of agreement across the conditions we tested. In particular, we were interested in whether it makes a difference to people’s levels of agreement that there is time in the actual world, first, whether the condition they are in is one in which there is *something* responsible for causation and change as opposed to there being nothing responsible for causation and change, and second, whether it makes a difference to their levels of agreement whether the condition they are in is one in which they are *actually* *tracking* what is responsible for time and causation, or *failing* to track that thing, and, third, whether it makes a difference to their levels of agreement whether the condition they are in is one in which what they are tracking, or failing to track, is similar to what they supposed it to be, or dissimilar to what they supposed it to be.

To test this, we ran a Kruskal-Wallis test to compare people’s levels of agreement to the actual world across all conditions.[[10]](#footnote-10) The result of this test showed that there was a significant difference between conditions in people’s levels of agreement that there is time in the actual world, *X2* (4, N = 505) = 9.520, *p* = .049. We then performed a follow-up Mann-Whitney U tests with a Bonferroni correction to test which conditions differed significantly from one another.[[11]](#footnote-11) However, these tests failed to show-up any significant differences. So, it does not seem to make a difference to people’s levels of agreement that there is actually time, that (a) there is something actually responsible for causation and change, or (b) that they are actually tracking the thing that is responsible for causation and change, or (c) that the thing they are tracking is similar to what they supposed it to be.

4. Discussion

Our results are surprising. None of our three hypotheses were vindicated. This is sufficiently surprising that some caution in interpreting these results is advisable. Although our participants were all high-quality participants who had previously successfully completed a large number of tasks, and although we asked a number of attention check questions and eliminated participants who failed to correctly answer those questions, there is always a danger that some participants may not properly understand the vignettes. Thus there is a danger that our results reflect confusion or ignorance rather than providing evidence that H1, H2, and H3, are false. Given that our results are quite surprising, particularly with respect to H3, we should give at least some credence to this being the case. That should be born in mind in what follows. For now, though, we will suppose that participants did adequately understand the vignettes and questions, and that we can straightforwardly interpret the results.

That being so, if Dual Role Functionalism is true H1 should have been vindicated. That is, we should have found that people judge that there is no time if our temporal phenomenology is not tracking what is responsible for causation and change. H1 was not, however, vindicated. People judge that there is time even when our temporal phenomenology is not tracking what is responsible for causation and change. People also do not judge more strongly that there is time when their phenomenology is tracking the thing that is responsible for causation and change compared to when the thing they are tracking is not responsible for causation and change: it made no difference to participant responses whether the phenomenology was tracking or non-tracking.

This finding is crucial. The core of Dual Role Functionalism is the thesis that time is *whatever it is,* that plays the dual functional roles of being the thing that grounds our temporal phenomenology *and* grounds causation and change. Our results strongly suggest that this is false. People are inclined to judge that there is time even if what their phenomenology is tracking does not in fact ground causation and change. Moreover, not only are they inclined to do so, but whether or not what they track is responsible for causation and change makes no significant difference to their judgements.

The second hypothesis (H2) was that people will judge that there is time even if temporal phenomenology is tracking something that is dissimilar to what they expected it to track, so long as what is being tracked is responsible for causation and change. On the one hand, our results suggest that it makes no difference to people’s judgements whether what is being tracked by their phenomenology is similar to what they expect or not. That, however, does not vindicate H2. H2 is only true if people’s judgements are *not* sensitive to whether what is being tracked is similar or dissimilar to what they expect, but *are* sensitive to whether what is being tracked is responsible for causation and change. We have just seen that people’s judgements are not sensitive to whether what is being tracked is responsible for causation and change. So H2 also fails to be vindicated as well.

Jointly, these two pieces of evidence are strong evidence (conditional on people in fact adequately understanding the vignettes) that Dual Role Functionalism is false. On the face of it that still leaves it open that something *like* Baron and Miller’s view might turn out to be right. For it might be that the second functional role, which appeals to there being something that plays the role of grounding causation and change, has been misarticulated. Perhaps whatever that second role is, it appeals to something other than causation and change.

Our findings, however, make it very unlikely that *any* version of functionalism that is like the one they offer, can be right. That is, it casts doubt on any version of Dual Role Functionalism, even one that spells out the second role quite differently. To see this, return to the third hypothesis. H3 says that people will judge that there is no time if not only are we not tracking what is responsible for causation and change, but, in addition, there is nothing to track. Notably though, even this hypothesis was not vindicated. This is surprising, given what participants in that condition are told. Recall that in all the conditions with actual non-tracking, participants are told that their temporal phenomenology is brought about by an evil demon. Yet they are still inclined to say that there is time in this circumstance.

This suggests that any version of Dual Role Functionalism is false. For the essence of views of that kind is that *whatever* plays the role of grounding our temporal phenomenology is time, as long as that thing is not fundamentally different from what we take our phenomenology to be tracking. But Demons are, surely, fundamentally different from what we take our phenomenology to be tracking. Indeed, the demon case is precisely the case that motivated Baron and Miller to this view in the first place. Since people do judge that there is time even when temporal phenomenology is grounded by a demon, this suggests that any version of Dual Role Functionalism is false.

That brings us to Seeming Role Functionalism. This is a radical view indeed, on which time is just *whatever* it is that grounds our having the temporal phenomenology we do, *absolutely* *regardless of what that thing is like*. Our results provide some support for this version of functionalism, insofar as they suggest that people are insensitive to the features of what it is that their temporal phenomenology is tracking. Indeed, we found that even in condition 5, in which not only is our phenomenology not tracking what is responsible for causation and change, but, in addition, there is nothing to track, 77.4% of participants still judge that there is time. This is consistent with Seeming Role Functionalism. Hence Baron and Miller might be right that our concept of time is a functional one: they might just have attributed to us the wrong functionalist concept.

Alternatively, it could be that the folk are not functionalists at all, and that their folk concept is in no way tied to their temporal phenomenology. Perhaps they simply have a non-functionalist concept of time that sets out very minimal (non-functional) conditions for that concept to be satisfied. If so, then we would expect that when participants are told that the actual world has been discovered to be a world in which their temporal phenomenology is the product of an evil demon that this will have little impact on whether their concept is satisfied.

The hypothesis that people have a very minimal non-functional concept is consistent with the results we find in conditions 1 to 4. In all these conditions there is something that could plausibly be thought to be temporal structure (a growing block or a C-series) and our results suggest that people are indifferent to whether or not their phenomenology is tracking that thing. If they have a concept whose content does not mention temporal phenomenology, this is to be expected. Nevertheless, this does not explain the results we found in condition 5, in which there is nothing in the actual (or counterfactual) world that includes even a one-dimensional sub-structure of ordered instants. So participants’ general willingness to judge that there is time in the actual world, if it is like *that*, cannot be explained by noting that participants only care about what structure the world has, and are indifferent to whether their phenomenology is tracking that structure. For if that were so, in condition 5 one would expect participants to judge that there is actually no time, given the structure present in that world. So, if participants do have a concept that is not functionalist, our results suggest that that concept must be *very* minimal in its requirements: it must be a concept on which it is not necessary for there to be time that there is even a C-series. That, too, would be quite a radical view about the content of the folk concept, and tends to provide at least some reason to think that something like Seeming Role Functionalism might in fact be correct.

Two final possibilities suggest themselves at this point. [[12]](#footnote-12) The first of these is that participants might have multiple non-functionalist concepts, such that in each of the vignettes at least *one* of these concepts is satisfied, Then it could be that what unites the multiple different concepts is that they are all sufficiently connected to the grounding of our temporal phenomenology.

While our data cannot rule this out, we think it somewhat unlikely. First, we see no good reason to imagine that people have multiple concepts of time. There are clear reasons why, for instance, someone might both a biological and a culinary concept of fish (say). But (physicists aside) it’s hard to imagine that we each have multiple folk concepts of time. Moreover, if we did, we might suspect that we would observe some evidence of interference between these concepts under the sorts of experimental conditions we find here. After all, we’d expect most of these concepts to issue in the judgement that there is time in condition 1; but surely only a very minimal concept indeed could issue in that judgement in condition 5. But we find no difference in the levels of agreement across the five conditions we tested. So even if judging that there is time in a scenario only requires *one* of our concepts to be satisfied, it would be surprising if we were not sensitive to the fact that in condition 5, by the lights of most of our concepts, it is not.

The second possibility is that participants have a single non-functionalist concept of time, but that it heavily disjunctive, such that a different disjunct is satisfied in the different scenarios. And, again, it could be part of that concept that the disjunct that is satisfied has to be appropriately connected to our temporal phenomenology. It’s not so easy to spell out the details of this option. A natural suggestion might be that our concept is such that time is A-theoretic, or B-theoretic, or C-theoretic, so long as that structure is appropriately connected to our temporal phenomenology. But that cannot be right, since it wouldn’t explain the results in condition 5. One of the disjuncts, at least, must be very minimal indeed. On the assumption that we can spell out that very minimal disjunct, however, it seems clear that this general proposal will accommodate the data we collected; indeed, it will be quite difficult to distinguish a highly disjunctive concept from a functionalist one.

When all is said and done, then, our results do not distinguish between these various possibilities. All we can say, here, is that on the assumption that participants correctly understood the vignettes and responded appropriately, our results undermine Dual Role Functionalism. We leave it for another day to try and gather evidence relating to these other hypotheses about the nature of our concept.

And, again, some caution is in order here given the very radical view that these results present us regarding people’s judgements about time. Having said that, we know from previous studies that people are quite reticent to conclude that actually, there is no time, and that in fact they judge there to be time across a surprising class of worlds. Since these results are broadly consistent with those, we should be careful about too quickly concluding that the present results are the result of confusion on the part of participants.

5. Conclusion

The results of this study do not tell us what content to attribute to the folk concept of time. But it does suggest that the sorts of functionalist accounts offered of late are not empirically supported. Having said that, the fact that the folk are willing, by and large, to judge that there is time in the actual world even when an evil demon is responsible for our temporal phenomenology, or even when there is no one-dimensional ordered substructure of instants, suggests that the folk concept of time must be one that is much more minimal, in its contents, than one would have expected. However, this will need to be confirmed by future research. If confirmed though, this would suggest that we ought to devote further attention to investigating various aspects of its content.

References

Ahler, D., Roush, C., & Sood, G. The micro-task market for lemons: data quality on Amazon’s Mechanical Turk. Unpublished manuscript, 22 January 2020. URL: http://gsood.com/research/papers/turk.pdf

Anderson, E. (2006) Relational Particle Models: 1. Reconciliation with Standard Classical and Quantum Theory. *Classical and Quantum Gravity*, 23(7), 2469–2490.

Barbour, J. (1999). *The End of Time*. (Oxford; New York: Oxford University Press).

\_\_\_\_\_\_\_. (1994a) The Timelessness of Quantum Gravity: I. The Evidence from the Classical Theory. *Classical Quantum Gravity*,11(12), 2853–2873.

\_\_\_\_\_\_\_. (1994b) The Timelessness of Quantum Gravity: Ii. The Appearance of Dynamics in Static Configurations. *Classical Quantum Gravity*,11(12), 2875–2897.

Baron, S. Evans, P and Miller, K. (2010). “From timeless physical theory to timelessness” “*Physics and Metaphysics*, special edition of *Humana.mente* edited by Claudio Calosi 13: 35-61.

Baron, S and K Miller (2015a) “What is temporal error theory?” *Philosophical Studies.* 172 (9): 2427-2444.

Baron, S. and K. Miller (2015b). “Our Concept of Time” in *Philosophy and Psychology of Time* edited by B. Mölder, V. Arstila, P. Ohrstrom. Springer. Pp 29-52

Boltzmann, L. (1964). *Lectures on gas theory 1896-1898* (S. G. Brush, Trans.). Berkeley: University of California Press.

Boroditsky L. (2001). Does language shape thought? English and Mandarin speakers’ conceptions of time. *Cognitive Psychology*, *43*, 1–22.

Boroditsky, L., Fuhrman, O., & McCormick, K. (2011). Do English and Mandarin speakers think about time differently? *Cognition*, *118*, 123–129.

Braddon-Mitchell, D and K Miller (2019). "Quantum Gravity, Timelessness, and the Contents of Thought". *Philosophical Studies.* 176 (07): 1807-1829

Callender, C. (2017). *What Makes Time Special?* OUP*.*

Casasanto, D., & Bottini, R. (2014). Mirror reading can reverse the flow of time. *Journal of Experimental Psychology: General*, *143*, 473–479.

Chen, J. Y. (2007). Do Chinese and English speakers think about time differently? Failure of replicating Boroditsky (2001). *Cognition*, *104*, 427–436.

Craig, W. L (2000). *The Tensed Theory of Time: A Critical Examination*. Kluwer Academic.

Deutsch, D. (1997) *The Fabric of Reality: The Science of Parallel Universes and Its Implications*. Penguin.

Effingham, N. and Melia, J. (2007). “Endurantism and Timeless Worlds”. *Analysis* 67(2): 140-147.

Evans. V. (2003). *The structure of time: Language, meaning and temporal cognition* John Benjamins Publishing.

Farr, M. (2012). On A- and B-theoretic elements of branching spacetimes. *Synthese,* 188(1), 85-116.

Farr, M. (2018). Causation and Time Reversal. *British Journal for the Philosophy of Science*.

Fuhrman, O., McCormick, K., Chen, E., Jiang, H., Shu, D., Mao, S., et al. (2011). How linguistic and cultural forces shape conceptions of time: English and Mandarin time in 3D. *Cognitive Science*, *35*, 1305–1328.

Gödel, Kurt (1949). An Example of a New Type of Cosmological Solutions of Einstein’s Field Equations of Gravitation. *Reviews of Modern Physics* 21 (3):447–450.

Latham, A. J. and Miller, K. (2020). “Time in a One-instant World”. *Ratio*. DOI: 10.1111/rati.12271

Latham, A. J., Miller, K and Norton, J. (2020) “Do the Folk Represent Time as Essentially Dynamical?” *Inquiry*.

https://doi.org/10.1080/0020174X.2020.1827027

Latham, A. J., Miller, K and Norton, J. (2019) “Is Our Naïve Theory of Time Dynamical?” *Synthese*. DOI: 10.1007/s11229-019-02340-4

Latham, A.J., Miller, K. and Norton, J. (2021). “An empirical investigation of the role of direction in our concept of time”. *Acta Analytica.* 36(1), 25-47DOI: 10.1007/s12136-020-00435-z

Maudlin, T. (2007). *The metaphysics within physics*. Oxford: Clarendon Press

McTaggart, J. M. E. (1908) The Unreality of Time. *Mind*,17(68), 457–474.

Oaklander, L. N. (2012). A-, B-, and R-theories of time: A debate. In B. Adrian (Ed.), *The Future of the Philosophy of Time* (pp. 1-24). New York: Routledge

Price, H. (1996). *Time's arrow & Archimedes' point: new directions for the physics of time*. New York: Oxford University Press.

Price, H. (2007). Causal perspectivalism In H. Price & R. Corry (Eds.), *Causation, physics, and the constitution of reality: Russell's republic revisited*. Oxford: Clarendon Press.

Rovelli, C. (1995) Analysis of the Distinct Meanings of the Notion of Time in Different Physical Theories. *Il Nuovo Cimento*,110 B(1), 81–93.

\_\_\_\_\_\_\_. (2007). The Disappearance of Space and Time. In *The Ontology of Spacetime*. Dennis Dieks (Ed.), 25–36. (Amsterdam: Elsevier).

\_\_\_\_\_\_\_. (2004). *Quantum Gravity*. (Cambridge: Cambridge University Press).

Schlesinger G. (1994). ‘Temporal becoming’ in N Oakland and Q Smith eds *The New Theory of Time*, New Haven CT: Yale University Press.

Sider, T. (2001). *Four-dimensionalism: an ontology of persistence and time.* Oxford University Press.

Sinha, C and P Gardenfors (2014). “Time, space, and events in language and cognition: a comparative view” *Annals of the New York Academy of Sciences*. *Issue: Flow of Time* 40: 1-10.

Smith, Q. (1993). *Language and Time.* New York: OUP.

Tallant, J. (2018). “An Error in Temporal Error Theory”. *Journal of the American Philosophical Association* 4(1): 14-32

Tegtmeier, E. (1996). *The Direction of Time: A Problem of Ontology, not of Physics*, in: J.Faye (Hrsg.) Perspectives on Time. Dordrecht

Tegtmeier, E. (2009). ‘Ontology of Time and Hyperdynamism.’ *Metaphysica* 10(2):185-198.

Williams, C. (1998). ‘B-time transition.’ *Philosophical Inquiry*, 20(3/4):59-63.

Williams, C. (2003). ‘Beyond A- and B-time.’ *Philosophia*, 31(1):75-91.

Zimmerman, D. W. (2008). ‘The Privileged Present: Defending an “A-Theory” of Time.’ In *Contemporary Debates in Metaphysics*, Sider, T., Hawthorne, J & Zimmerman, D. W. (eds.), 211–225 (Oxford: Blackwell).

1. Some of these theories are probably best thought of as ones in which there is fundamentally no one-dimensional substructure of ordered instants, but such a structure emerges from something fundamentally non spatio-temporal. These versions of such theories are unlikely to be folk timeless. [↑](#footnote-ref-1)
2. A-theoretic views posit real, i.e. irreducible, tense: they suppose that there is an objective fact as to which moment is present, and that which moment that is, changes. A-theorists posit an A-series: an ordering of times in terms of intrinsic, monadic, irreducible properties of being present, being past and being future. On such views there is genuine, or robust, temporal passage. Hence they are often also known as dynamical views (and we will use both terms interchangeably). A-theorists include Zimmerman (2008), Smith (1993), and Schlesinger (1994). [↑](#footnote-ref-2)
3. B-theoretic views posit no real tense: they hold that no moment is *objectively* present, instead, every moment is present at itself, just as every location is here at itself. B-theorists posit a B-series ordering of times in terms of the unchanging B-relations of *earlier-than*, *later-than­* and *simultaneous with*. As we will understand it, the B-theory is the view that time has a direction. B-relations are directed, asymmetric, relations, which generate a temporal ordering according to which there is a fact regarding which direction is past, and which future. B-theorists include Maudlin (2007), Oaklander (2012), Tegtmeier (1996; 2009). [↑](#footnote-ref-3)
4. We take the C-series to be an undirected asymmetric ordering relation. On this understanding, C-theorists deny that time has a direction so there is, for instance, no fact of the matter as to which of two temporal boundary conditions (if there are any) is the first moment of time, and which the last moment. C-theorists include Farr (2012; 2018), and Price (1996). [↑](#footnote-ref-4)
5. Henceforth we use angle brackets to pick out concepts. [↑](#footnote-ref-5)
6. See for instance Williams (1998; 2003), McTaggart (1908), and Gödel (1949) who hold such a view. Others hold the somewhat weaker view that the A-theory better captures our folk concept of time. See for instance Zimmerman (2008), Smith (1994), Craig (2000), and Schlesinger (1994). [↑](#footnote-ref-6)
7. See Baron and Miler (2015a), and Latham, Miller, and Norton (2021). [↑](#footnote-ref-7)
8. And in fact, we know that they do. See Latham, Miller, and Norton (2019). [↑](#footnote-ref-8)
9. These inclusion criteria (along with attentional checks) have been observed to reduce the presence of suspicious and insincere responding when using Amazon Mechanical Turk (Ahler, et al. ms). [↑](#footnote-ref-9)
10. This was done due to violations to the assumption of normality and homogeneity of variance. However, running the analysis as one-way ANOVA with follow-up pairwise comparisons using a Bonferroni correction does not change the results reported here.

    We also ran a separate Kruskal-Wallis test to compare people’s levels of agreement to the world described across all conditions. The result of this test showed that there was a significant difference between conditions in people’s levels of agreement that there is time in the world described, X2 (4, N = 505) = 10.113, p = .039. However, follow-up Mann-Whitney U tests with a Bonferroni correction failed to show-up any significant differences. Running the analysis as one-way ANOVA with follow-up pairwise comparisons using a Bonferroni correction does not change the reported omnibus test results reported here. However, it does show one significant difference in levels of agreement between condition 1 (counterfactual tracking, actual tracking, similar) and condition 5 and (counterfactual non-tracking, actual non-tracking). [↑](#footnote-ref-10)
11. Whenever you perform multiple statistical tests on the same data there in an increased chance of encountering type-one errors (false positives). The Bonferroni correction helps correct this problem. [↑](#footnote-ref-11)
12. With thanks to an anonymous referee who made this suggestion. [↑](#footnote-ref-12)