**Do the Folk Represent Time as Essentially Dynamical?**

**Abstract**

Recent research (Latham, Miller and Norton, 2019) reveals that a majority of people represent actual time as dynamical. But do they, as suggested by McTaggart and Gödel, represent time as *essentially* dynamical? This paper distinguishes three interrelated questions. We ask (a) whether the folk representation of time is *sensitive* or *insensitive*: i.e., does what satisfies the folk representation of time in counterfactual worlds depend on what satisfies it actually—sensitive—or does is not depend on what satisfies it actually—insensitive, and (b) do those who represent actual time as dynamical, represent time in all possible worlds as dynamical—what we call insensitive dynamism—or do they represent time in all possible worlds as dynamical *only conditional on the actual world in fact being dynamical*—what we call sensitive dynamism and (c) do dynamists and non-dynamists deploy two different representations of time, or deploy the same representation, but disagree about what actually satisfies that representation? We found no evidence that the folk representation of time is sensitive, or that the folk representation of time is essentially dynamical in either sense, though we did find evidence of a largely (though not universally) shared representation, on which dynamical features are sufficient, but not necessary, for time.

**1. Introduction**

Since at least as far back as McTaggart (1908), appeals have been made to the folk representation,[[1]](#footnote-1) concept, or theory, of time. We will talk of a folk representation of time, and the content of that representation, but we could talk about a folk or naïve theory of time[[2]](#footnote-2) or a folk concept of time.[[3]](#footnote-3) McTaggart (1908), and following him, Gödel (1949), suggested that our folk representation of time is a representation of something essentially dynamical,[[4]](#footnote-4) and who each, on that basis, concluded that there is no time (and necessarily so) since nothing could be dynamical in that way. Others have drawn different conclusions, but have agreed that it is conceptually necessary that time passes (Williams, 1998; 2003).[[5]](#footnote-5)

At the very least, many dynamists, and some non-dynamists, think that dynamism gets *something* *right* about the way we ordinarily think about time.[[6]](#footnote-6) Dynamists conclude that this gives us defeasible reason to embrace dynamism.[[7]](#footnote-7) Even non-dynamists often concede that they incur the burden of explaining why dynamism gets something right about how we ordinarily think about time, given that time is not in fact dynamical.[[8]](#footnote-8)

The claim that dynamism gets something right about the folk representation of time requires unpacking. To do so, we need to articulate some central notions to which we will appeal.

First, we take a *representation* *of actual time* to be something like a (mental) model of the way the actual world is, with regard to time. Philosophical models of time—presentism, the growing block theory, the block universe model and so on—are examples of such models. We make no assumption that non-philosophers’ representations of actual time are as complete or consistent as these models, but do assume that these representations can be more, or less, similar to these philosophical models. We will call those who represent actual time as being more similar to a dynamical than a non-dynamical model, *dynamists*, and those who represent actual time as more similar to a non-dynamical than a dynamical model, *non-dynamists.*

By a *representation* *of time* we mean a representation of *what it is for something to be time*. This representation is what guides (or perhaps is constituted by) people’s dispositions to make judgements about whether some actual, or counterfactual, world, contains time. A representation of time, then, outstrips a representation of actual time. The latter is a representation of how actual time is taken to be; the former is a representation of what it is to be time: of what is *essential* to time.

We suppose that representations can be tacit, insofar as individuals who employ those representations may not be able clearly to articulate their content, let alone provide anything like necessary and sufficient conditions for something to *satisfy* those representations (i.e. answer to the content of those representations). Nonetheless, we assume that people’s behaviour—linguistic and otherwise—provides some evidence for the content of even tacit representations. If we describe a world to you, in a way that does not mention temporal relations, and ask, ‘is this world one that contains time?’ you will use your (likely tacit, unless you are a philosopher) representation of time, to decide whether or not it contains time. Prior to considering this question, you may have had no explicit view as to whether that world contains time. Nevertheless, there is something about you which means that if you were asked that question, you would say one thing, or another (or have no idea at all). In effect, what we have just described is a simplified version of the methodology we deploy in the studies we describe in §3.

We begin, in §2, by outlining extant research regarding the content of the folk representation of time and disambiguating a number of distinct questions regarding whether the folk represent time as something that is essentially dynamical. It is important to bear in mind that our aim is to address these more specific questions, not to fully explicate the content of the folk representation of time. It is also important to note that we do not assume that there is a unique, shared, folk representation of time even amongst the population we tested. Indeed, as we will see (§2), previous empirical research suggests that there may be several representations present in this population. One of the questions we aim to address is whether there is evidence that dynamists and non-dynamists share a representation, or employ two distinct representations. Nevertheless, for now we will talk of ‘the’ folk representation of time.

It is also important to note the limitations of this research. Social scientists have found cross-cultural and cross-linguistic differences across a broad variety of tasks that are relevant to people’s representation of time (more on this below), though whether this shows a difference in the underlying representation of time, or merely in the ways in which people describe that representation in language and gesture, is unclear (for discussion see Callender, 2017). Our sample population is drawn exclusively from the US, and we make no claims regarding whether our results generalise to other, quite different, populations. So everything we say ought be relativised to the population we sampled.

Bearing this in mind, §3 outlines our methodology, analyses and results. §4 presents our discussion of these results. Interestingly, our results suggest that non-dynamists have been too concessive; only a small subpopulation of the population tested think that dynamism is necessary for time, and, indeed, another small subpopulation thinks that dynamism is *incompatible* with there being time.

**2. The folk representation of time**

There has been a good deal of social science research into the ways in which people talk about, use gestures, language, and written diagrams, to represent time (see Evans, 2003:14; Sinha and Gardenfors, 2014; Boroditsky, Fuhrman, and McCormick, 2011; Fuhrman, McCormick, Chen, Jiang, Shu, Mao, and Boroditsky, 2011; Chen, 2007; Boroditsky, 2001; Casasanto and Bottini, 2014; Núñez, Cooperrider, Doan, and Wassmann, 2012). There has also been recent empirical work investigating the extent to which people report having a *phenomenology* as of time passing (Latham, Miller and Norton, forthcoming). Extant research, however, has not targeted the key question with which this paper concerns itself: namely, whether the folk representation of time is a representation of something essentially dynamical.

Recent research in experimental philosophy goes a little further towards this aim. Latham, Miller and Norton (2019) investigated US residents’ representation of actual time by presenting participants with vignettes and asking which vignette participants think describe a universe that is most like our own. Their first experiment found that 14.5% chose the moving spotlight theory, 17.4% chose presentism, 34.3% chose the growing block, 17.2% chose the block universe, 9.3% chose the C-theory and 7.3% chose the quantum gravity universe. In the second experiment, this distribution of results was somewhat different, though across both experiments there were robust results which showed that ~70% of people represent *actual* time as dynamical and ~30% represent it as non-dynamical.

They concluded that participants’ representations of actual time robustly track the difference between dynamical and non-dynamical models, but may not be sufficiently developed for participants to be sure which dynamical, or non-dynamical, model is most like our world. Hence they concluded that there is reason to suppose that there are at least two folk representations of actual time amongst the population they tested: one dynamical and one non-dynamical. That provides *prima facie* reason to suppose there to be at least two representations *of time*, amongst the population we sampled. We return to this issue shortly. First, we clarify the key question we investigate: namely whether the folk representation of time is a representation of something essentially dynamical.

Let us say that a property, P, is essential to *folk time,* just in case necessarily, the folk representation of time is satisfied by something only if that something has P. Hence dynamical properties are essential to folk time iff in every world, something satisfies the folk representation of time only if that thing has dynamical properties. Matters are, however, slightly more complex than this. For it might be that what satisfies the folk representation of time counterfactually, *depends* on what satisfies it actually: the representation is s*ensitive*. Alternatively, it might that what satisfies the folk representation of time counterfactually does not depend on what satisfies it actually: the representation is *insensitive*.

Natural kind concepts are paradigmatic sensitive concepts: something satisfies the concept, of say, water, counterfactually, just in case that something is micro-physically *just like whatever actually satisfies that concept*. Perhaps water is, necessarily, H20 if it is H20 actually, but is necessarily XYZ if it is XYZ actually. If so, our representation of water is one on which it is *sensitively necessary* that water is H20. It has been suggested that some representations have complicated *hierarchical* sensitive content. For example, Hawthorne (2002) and Braddon-Mitchell (2003) suggest that our phenomenal concepts are concepts according to which if actually there are dualistic properties accessible through revelation, then phenomenal properties are those properties, and necessarily so. Otherwise, phenomenal properties are just whichever properties play certain functional roles. The idea, here, is that if there are actually such dualistic properties then they are a better deserver to count as satisfying our representation, and indeed, will be necessary for that representation to be satisfied. But if there are not such properties, then something else—whatever plays certain functional roles—will do.

We can now disambiguate the claim that the folk representation of time is a representation of something essentially dynamical. One disambiguation is the *insensitively-dynamical* thesis: the claim that regardless of what the actual world is like, the folk representation of time is only satisfied in dynamical worlds. McTaggart and Gödel endorse this thesis. This thesis predicts that people will judge that there is time only in dynamical worlds, and will make that judgement regardless of whether the actual word is dynamical or not. So if actually there are no dynamical properties, it predicts that people will be error theorists about actual time.

The second disambiguation is the *sensitively-dynamical* thesis: the claim that what satisfies the folk representation, in every world, is something dynamical, but *only* *if* what actually satisfies that representation is dynamical.[[9]](#footnote-9) Though this thesis is weaker than the insensitively-dynamical thesis, it captures the intuition, shared by many, that worlds containing dynamical properties are better deservers to satisfy our representation of time than are worlds that fail to contain such properties. This thesis predicts that if people believe that the actual world is dynamical, they will judge that there is time actually, and will judge that there is time only in dynamical counterfactual worlds—and not in non-dynamical counterfactual worlds—but if they believe that the actual world is non-dynamical, they will judge that there is time actually, and will judge that there is time in both dynamical and non-dynamical counterfactual worlds.

Both the sensitively-dynamical and insensitively-dynamical theses are disambiguations of the hypothesis that the folk represent time as essentially dynamical. The alternative hypothesis is that the folk represent time as dynamical, but not *essentially* dynamical. A natural view of this kind is that the folk representation is one on which the presence of dynamical properties is *sufficient*, but not *necessary*, for there to be time, and that is so regardless of whether our world is dynamical or not (the representation is insensitive to whether dynamism is true actually). Perhaps dynamical properties are sufficient because they not only order events, but that ordering has a *direction*—there is, as it were, an arrow that points from past, to future—such that if a world has two boundary conditions, there is a fact of the matter which is the first moment of time, and which is the last moment of time. Equally though, the presence of these properties may not be necessary, because the non-dynamical B-theoretic picture is also one on which events are ordered, and on which that ordering has a direction: the direction that is generated by the B-theoretic earlier-than and later-than relations. So we might call this the *directionally-sufficient* thesis.[[10]](#footnote-10) This thesis predicts that people will judge that there is time in both dynamical and non-dynamical worlds, regardless of whether the actual world is dynamical or non-dynamical.

Each of these three theses presupposes that there is a unique, shared, folk representation of time. In what follows we address two questions. First, is there a unique shared folk representation of time (shared representation thesis) or not (multi-representation thesis) and if so, which, if any, of these three theses is correct about the content of that shared representation? Second, if there is no shared representation, then what is the distribution, amongst the population we test, of people who employ an insensitively-dynamical, a sensitively-dynamical, or a directionally-sufficient, folk representation of time?

In order to address these questions, we distinguish scenarios considered as actual, from scenarios considered as counterfactual. We take scenarios considered as actual to be ways the actual world might turn out to be, for all we know: that is, ways we cannot rule out *a priori*.[[11]](#footnote-11) One considers a dynamical scenario as actual when one supposes that it turns out, or one discovers that, the actual world is dynamical. For the purposes of our studies, we ask participants to suppose that they *discover* that our universe (the term we use in the vignettes) is some particular way; this corresponds to them considering some scenario as actual. We then ask participants to respond to certain questions about the actual universe, on the assumption that they make that discovery.

By contrast, scenarios considered as counterfactual are simply scenarios that are counterfactual relative to some scenario that is taken to be actual. For the purposes of this study, we asked participants about universes that are specified to ***not*** be our universe; this corresponds to them considering some scenario as counterfactual. Importantly, whenever we asked participants to consider a dynamical counterfactual scenario, we specified that the actual world has been discovered to be non-dynamical, and whenever we asked participants to consider a non-dynamical counterfactual scenario, we specified that the actual world has been discovered to be dynamical. That is, we ask people their views about counterfactual scenarios, conditional on them taking some different scenario to be actual.

We assume that what individuals say, across a range of scenarios, regarding what satisfies their representation, is defeasible evidence regarding the content of that representation. It is defeasible because what participants say is only defeasible evidence regarding what they would, *in fact,* say, were they to make the relevant discoveries about the actual world. After all, people may not be fully adept at simulating what they *would* say, *were* they to make certain actual discoveries, given that in fact they do think that they will make such discoveries. One might worry that participants will find it difficult to imagine that our universe is other than they in fact take it to be, and more difficult again to imagine counterfactual universes, conditional on our universe being other than they in fact take it to be. We return to this issue in §4.

 Let’s return to the question of whether we ought think there is a shared folk representation of time. We noted, previously, that the prior study of Latham et al. (2019) seems to suggest *prima facie* that there will be at least two such representations. In fact, matters are more complicated than that. Latham et al.’s results are consistent with there being a shared folk representation of time: but they are not consistent with all three theses about the content of that representation. Since Latham et al. found that ~30% of the population represent actual time as non-dynamical, it follows that this 30% of people do not employ an insensitively-dynamical representation. At least, this follows insofar as we can safely assume that these people are not error theorists about actual time. So we already know that, as stated, the insensitively-dynamical thesis is false. It could still be, of course, that the multi-representation thesis is true, and a large percentage of the population–i.e. the dynamists—employ this representation.

By contrast, Latham et al.’s results are consistent with there being a shared representation whose content is sensitively-dynamical, or directionally-sufficient. Recall that the former thesis predicts that if we specify that the actual world is dynamical, dynamists and non-dynamists will agree that there is time in the actual world, but no time in a counterfactual non-dynamical world. However, if we specify that the actual world is non-dynamical, dynamists and non-dynamists will agree that there is time in the actual world and also that there is time in a counterfactual dynamical world. By contrast, the shared directionally-sufficient thesis predicts that both dynamists and non-dynamists will agree that there is time in every dynamical or non-dynamical world they evaluate, no matter how the actual world is specified to be.

Bearing all this in mind, let’s make some predictions. Many philosophers have thought that dynamism gets something right about *the* folk representation of time. This suggests that they hold that there is a shared representation (shared representation thesis) and that this representation represents something essentially dynamical (sensitively or insensitively-dynamical thesis). Since Latham et al.’s previous findings are inconsistent with the shared insensitively-dynamical thesis, this gives us reason to predict that we will find evidence consistent with the shared sensitively-dynamical thesis.

Overall, then, we predicted (a) evidence of sensitivity, evinced by a statistically significant difference in the pattern of responses to scenarios considered as counterfactual between those who were told that a dynamical scenario is actual, and those who were told a non-dynamical scenario is actual (sensitivity) and (b) evidence of sensitive-dynamism, evinced by significantly higher levels of agreement that there is time in an actual non-dynamical world versus in a counterfactual non-dynamical world when the actual world is taken to be dynamical (c) that both dynamists and non-dynamists will agree that if a dynamical or non-dynamical scenario is actual there is time in that scenario, and there will be no statistically significant difference between their levels of agreement and (d) both dynamists and non-dynamists will agree that there no time in a non-dynamical scenario considered as counterfactual, if a dynamical scenario is actual, and there will be no statistically significant difference between their levels of agreement.

**3. Experimental Design and Results**

In both experiments we aimed to determine:

(a) what participants *in fact* think our world is like: dynamical or non-dynamical and

(b) what participants say about whether a dynamical or non-dynamical scenario contains time, if they discover that scenario to be actual (where that discovery can either accord with what they in fact think the world is like, or can fail to accord with what they think our world is like) and

(c) what participants say about whether a dynamical counterfactual scenario contains time on discovering that a non-dynamical scenario is actual, and whether a non-dynamical counterfactual scenario contains time, on discovering that a dynamical scenario is actual.

In effect, then, we have a three-way index: what people in fact think our world is like; whether people think there is time in a scenario, when imagined to be actual, and whether people think there is time in some counterfactual scenario, given that they take a different scenario (dynamical or non-dynamical) to be actual.

In each experiment we presented participants with pairs of vignettes. One vignette describes a dynamical scenario, and one describes a non-dynamical scenario. To gain information about what participants think our world is in fact like, they read both vignettes and then say which they think is most like our world. Participants then see one of the vignettes again (which they see first is randomised) and are told that scientists have discovered that our universe is just like the universe described in the vignette. They are then asked whether the vignette describes a universe that contains time. The process is then repeated for the second vignette. This gives us information about what people say about whether there is time in a scenario considered as actual. It also allows us to see what people say about there being time in a scenario, considered as actual, given what they *in fact* think the actual world is like. Finally, in each experiment, all participants see both vignettes side by side. Participants are told that vignette 1 is the actual universe, and vignette 2 is a parallel universe (i.e. counterfactual scenario), and then asked whether there is time in the parallel universe. They are then told that vignette 2 is the actual universe, and vignette 1 is a parallel universe, and are once asked whether there is time in the parallel universe. The order in which participants considered worlds as counterfactual was randomised.

Given our aims, it was important that the scenarios described did not explicitly mention time, times, or temporal relations, or otherwise use temporal locutions. For instance, if a scenario is described in terms of there being events that are earlier-than, and later-than, other events, this strongly suggests that there is time in that scenario. Hence we wrote the vignettes in ‘time-neutral’ form: describing the scenarios without using temporal locutions. Since this makes it difficult to visualise (or otherwise conceptualise) the scenarios in question, we introduced the locution: ‘some scientists, philosophers and theologians in Universe [C/D/E] think that…’ where the ellipses included a description of the scenario using temporal language. Our aim was to provide both a time-neutral and non-neutral description of the scenarios, so that participants could then bring to bear their representation of time to determine whether they think there is time in the scenario thus described.

Due to this, we had concerns that participants might not understand the vignettes. We did two things to check whether this was so. First, we used vignettes that were minimally amended from those used by Latham et al. We re-ran the Latham et al. study using time-neutral variants of their 6 vignettes (only three of which are used in the present two experiments), asking participants which of the universes described is most like our universe. We reasoned that if the distribution of participants across the time-*neutral* vignettes was similar to Latham et al.’s results, this would go some way towards showing that participants understood the vignettes as intended. The distributions were similar.[[12]](#footnote-12) Second, we included three comprehension questions at the end of the vignettes in the present studies, and the results we report below only include those from participants who correctly answered at least 2 of the 3 questions for both vignettes.

**3.1 Experiment One Method**

*3.1.1 Participants*

421 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated $2 for approximately 20 minutes of their time. 64 participants had to be excluded for failing to follow task instructions. This means that they failed to answer the questions (55), or failed an attentional check question (9). The remaining sample was composed of 357 participants (aged 20-99; 150 female). Mean age 35.30 (*SD* = 11.87). 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 see a total of four conditions. Condition 1: actual dynamical scenario; condition 2: actual non-dynamical scenario; condition 3: actual dynamical scenario, with *counterfactual* non-dynamical scenario; condition 4: actual non-dynamical scenario, with *counterfactual* dynamical scenario. All participants begin by reading both vignettes, which are as follows:

The time-neutral dynamical (presentist) scenario:

Imagine a universe (Universe C) in which the distance relations between objects are purely spatial. Spatial relations are relations such as Mike being two feet from Lily, or Boston being 16000kms from Sydney. In this world any two objects are separated by some spatial distance, and no two objects are separated by any other distance relations. Since in Universe C there are only three spatial dimensions, Universe C is a giant three dimensional object. In Universe C, which objects exist, and what properties those objects have, *changes.* So Universe C is a giant *changing* three dimensional object. Some scientists, philosophers and theologians in Universe C think that everything that exists—everything that is part of the giant three dimensional object—is in the objective present. They think that objects that existed in the past no longer exist, and that objects that will exist in the future do not yet exist.

 For example, in Universe 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. But when the event of P1 hitting the particle detector exists, the event of P2 hitting the particle detector does not exist, and when the event of P2 hitting the particle detector exists, the event of P1 hitting the particle detector does not exist. In Universe C events can be ordered in terms of their coming into, and out of, existence. This ordering of events has a single, correct, direction. In this case, the event of P1’s hitting the detector is prior, in the ordering, to the event of P2’s hitting the detector. Or, as we might say, the direction 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).

Participants are then presented with the following comprehension questions:

1. Scientists in Universe C think that the present is real, the past and future are not.
2. Scientists in Universe C think that which events are present, changes.
3. Scientists in Universe C think that some past events are present.

The time-neutral non-dynamical (B-theoretic) scenario:

Imagine a universe (Universe B) where 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 Universe B 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 think these relations are the relations of earlier-than, later-than, and simultaneous-with. In Universe B no set of events is special. 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 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. The event of P1 hitting the particle detector is prior, in the ordering, to the event of P2 hitting the detector. That relation never alters; it is always the case that the event of P1 hitting the detector is prior to the event of P2 hitting the detector. Or, as some of the scientists, philosophers and theologians in Universe B would put it, the event of P1 hitting the detector is earlier than the event of P2 hitting the detector. The ordering of events that is generated via these relations 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).

Participants are presented by with the following comprehension questions:

1. Scientists in Universe B think that the present is real, the past and future are not.
2. Scientists in Universe B think that the present moves from earlier time to later times. For instance, they think the present was one located in the year 1009, and is now located in the year 2019, and will be located in the year 2100.
3. Scientists in Universe B think that the present is just whichever time one is at. For instance, they think that presentness does not move from earlier times to later times. Every time is present to the individuals located at that time.

After reading both vignettes, participants are asked the question: “which universe do you think is most like our own?” and are given two options to choose from: Universe C and Universe B. They are then asked to indicate their level of confidence in that judgement, on a Likert scale of 1 (very unsure) - 7 (very sure). Participants who answered two or more of the comprehension questions incorrectly, about the vignette they thought was most like our universe, were excluded from all of the analyses. At no point could participants return to a previous screen. Those we subsequently refer to as dynamists are those who chose universe C, and those we refer to as non-dynamists are those who chose universe B, as being most like our universe.

Participants then see both vignettes (on separate screens) in random order. For each vignette, they are asked to imagine that that universe described has been discovered to be just like the actual universe. They are then presented with the statement “there is time in Universe [C/B]” and asked how strongly they agree/disagree on a Likert scale of 1 (strongly disagree) - 7 (strongly agree). Participants then see both vignettes side by side. In random order, participants are told that universe C is just like the actual universe, and universe B is a parallel universe, and told that universe B is just like the actual world, and universe C is a parallel universe. The instructions are the following “imagine scientists discover that the *actual*Universe (the one where you and I live) is exactly like Universe [**C**/B]. Now imagine scientists are suddenly able to observe a *parallel* Universe. The parallel Universe is like the actual universe in many respects: it contains many of the same things as our universe. However, the *parallel* Universe is exactly like Universe [C/**B**]. The scientists are right about this: the actual Universe is exactly like Universe [**C**/B] and the parallel Universe is exactly like Universe [C/**B**]. Imagining that is the case, please answer the following question about the *parallel* Universe. Remembering that the actual universe is just like Universe **[C**/B], and the parallel universe is just like Universe [C/**B]**.” Participants are then asked to indicate their level of agreement, on a Likert scale of 1-7, with the following statement: “there is time in the parallel universe.” They are then asked to indicate their level of confidence in their previous judgement.

**3.2 Experiment Two Method**

*3.2.1 Participants*

411 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated $2 for approximately 20 minutes of their time. 61 participants had to be excluded for failing to follow task instructions. This means that they failed to answer the questions (55), or failed an attentional check question (6). The remaining sample was composed of 350 participants (aged 18-72; 152 female; 1 prefer not to answer). Mean age 36.71 (*SD* = 12.00). 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.

*3.2.2 Materials and Procedure*

The procedure for experiment two was just like that for experiment one, except that the dynamical scenario is a time-neutral vignette describing a growing block. That vignette is below:

Imagine a universe (Universe E) where 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 E 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 E 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).

Participants are presented by with the following comprehension questions:

1. Scientists in Universe E think that the present is real, the past and future are not.
2. Scientists in Universe E think that the present moves as new events come into existence.
3. Scientists in Universe E think that the present is just whichever time one is at. For instance, they think that presentness does not move from earlier times to later times. Every time is present to the individuals located at that time.

**3.3 Analyses**

*3.3.1 Experiment One Main Results*

Before reporting the statistics and details, let’s begin with a summary of our main findings from experiment one.

First, we predicted that we would find evidence in favour of the shared sensitively-dynamical thesis. Thus we predicted that dynamists and non-dynamists would agree that if the actual scenario is non-dynamical then there is time (both actually and in a counterfactual dynamical scenario) but that if the actual scenario is dynamical then there is time actually, but not in a counterfactual non-dynamical scenario (the world-sensitivity part of the thesis). We found no evidence to support this hypothesis. Which scenario participants are told is actual, had no statistically significant effect on their judgments about time in counterfactual scenarios.

Second, we predicted that both dynamists and non-dynamists would agree that there is time in a dynamical scenario considered as actual, with no statistically significant difference between their levels of agreement. This prediction was partially supported. In both groups, a significant majority judged that there is time in a dynamical scenario considered as actual, but there was a statistically significant difference between their levels of agreement. Both groups gave more positive judgments when evaluating a scenario that was most like they *in fact* take the actual world to be. So dynamists tended to give more positive judgments when evaluating presentist scenarios, and non-dynamists tended to give more positive judgments when evaluating B-theoretic scenarios.

Third, we predicted that both dynamists and non-dynamists will agree that there is no time in a counterfactual non-dynamical scenario, conditional on a dynamical scenario being actual, with no statistically significant difference between their levels of agreement, and that both dynamists and non-dynamists will agree that there is time in an actual non-dynamical scenario, and there will be no statistically significant difference between their levels of agreement. These predictions were only partially supported. We found that a significant majority of non-dynamists judge that there *is* time in both actual and counterfactual non-dynamical scenarios. Dynamists, by contrast, were split between judging that there is time, and judging that there is no time or being indifferent, in both actual and counterfactual non-dynamical scenarios. Moreover, we find mean judgements significantly higher than 4 in all scenarios. There was also a statistically significant difference between these groups’ levels of agreement, as a result of participants’ larger judgments when evaluating a scenario that matched what they in fact think the actual world is like.

We now move on to present the detailed statistics. Of the original 357 participants, 145 participants correctly answered at least 2 of the 3 comprehension questions for *both* the dynamical and non-dynamical vignettes. The results outlined above (and presented below) include only these participants.

80 participants judged that the non-dynamical scenario was most like our world and 65 participants judged that the dynamical scenario was most like our world. There was no significant difference in confidence between the non-dynamists (*M* = 5.08, *SD* = 1.23) and the dynamists (*M* = 5.18, *SD* = 1.22; *t*(143) = -0.535, *p* = .594).

Table 1 reports levels of agreement to the sentence “There is time in Universe [B/C]”. Participants who chose 1-3 on the Likert scale are reported as disagreeing, while participants who chose 5-7 are reported as agreeing. Thus, weak agreement is reported as agreement in what follows. To test whether the mean response significantly differed from 4 in each scenario we ran separate one-sample t-tests for each condition for each group (the two most right-hand columns). If the mean is significantly above 4, then, overall, people might think that there is time; if the mean is significantly below 4, then, overall, people might think there is *no* time; finally, if the mean does *not* differ significantly from 4, then, overall, people might be indifferent.

*Table 1.* *Levels of agreement that there is time in worlds taken as actual or counterfactual. In parentheses, we note how the actual world is taken to be when making the judgement about the counterfactual world.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **%Yes** | **%No** | **%4** | **Mean** | **SD** | ***t*-value** | ***p*-value** |
| **Dynamists (*N* = 65)** |
| Actual Presentism | 83.1 | 13.8 | 3.1 | 5.60 | 1.56 | 8.273 | <.001 |
| Counterfactual Presentism (Actual B-Theory) | 75.4 | 15.4 | 9.2 | 5.31 | 1.51 | 6.984 | <.001 |
| Actual B-Theory | 60 | 32.3 | 7.7 | 4.69 | 1.86 | 2.998 | .004 |
| Counterfactual B-Theory (Actual Presentism) | 61.5 | 27.7 | 10.8 | 4.83 | 1.83 | 3.670 | <.001 |
| **Non-dynamists (*N* *=* 80)** |
| Actual Presentism | 70 | 25 | 5 | 4.89 | 1.68 | 4.714 | <.001 |
| Counterfactual Presentism (Actual B-Theory) | 68.7 | 27.5 | 3.8 | 4.85 | 1.69 | 4.493 | <.001 |
| Actual B-Theory | 88.7 | 8.8 | 2.5 | 5.68 | 1.27 | 11.791 | <.001 |
| Counterfactual B-Theory (Actual Presentism) | 87.4 | 8.8 | 3.8 | 5.51 | 1.31 | 10.311 | <.001 |

The results of our t-tests show that overall, dynamists and non-dynamists agree that there is time in *all* the scenarios that we tested. That is, overall, dynamists and non-dynamists agree that there is time in presentist and B-theoretic worlds.

However, while the results in Table 1 go some way toward speaking to our predictions, they do not tell us whether the *majority* of dynamists or non-dynamists judge that there is time in any given condition. For instance, consider for the moment Row 3 of the table where we find that 60% of dynamists judge that there is time in a B-theoretic world considered as actual, but 40% judge that there is no time, or neither agree nor disagree that there is time. Is this split statistically significantly different from a 50/50 split? That is, is it the case that a statistically significant *majority* judge that there is time?

To test this, we ran separate one-way χ2 tests for each condition for each group (see Table 2 below). First, we divided participants into those who responded that there was time in the scenario (Yes) and those who said that there was not (No) or who said that they neither agreed nor disagreed that there was time (4). We then tested whether the split (Yes vs. No/4) was statistically different from 50/50.

*Table 2. Proportion of participants who responded that there was time in the scenario (Yes) and those who said that there was not (No) or who said that they neither agree nor disagreed that there was time.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **%Yes** | **%No/4** | **χ*2*** | ***p-*value** |
| **Dynamists (*N* = 65)** |
| Actual Presentism | 83.1 | 16.9 | 28.446 | <.001 |
| Counterfactual Presentism (Actual B-Theory) | 75.4 | 24.6 | 16.754 | <.001 |
| Actual B-Theory | 60 | 40 | 2.600 | .107 |
| Counterfactual B-Theory (Actual Presentism) | 61.5 | 38.5 | 3.462 | .063 |
| **Non-dynamists (*N* = 80)** |
| Actual Presentism | 70 | 30 | 12.800 | <.001 |
| Counterfactual Presentism (Actual B-Theory) | 68.7 | 31.3 | 11.250 | .001 |
| Actual B-Theory | 88.7 | 11.3 | 48.050 | <.001 |
| Counterfactual B-Theory (Actual Presentism) | 87.4 | 12.6 | 45.000 | <.001 |

The results of our one-way χ2 tests show that the majority of non-dynamists respond that there is time in *all* the scenarios that we tested. That is, the majority of non-dynamists respond that there is time both in presentist and B-theoretic worlds, both actual and counterfactual. However, only in presentist worlds do the majority of dynamists respond that there is time. Dynamists are divided between responding that there is time and responding that there is no time or neither agreeing nor disagreeing that there is time, in B-theoretic worlds, whether they are considered as actual or counterfactual.

Finally, in order to compare people’s responses across factors, levels of agreement were analysed using a repeated-measures ANOVA. The ANOVA included within-subjects factors of context (actual; counterfactual) and theory (presentism; B-theory) and a between-subjects factor of group (dynamists versus non-dynamists). The 2x2x2 repeated-measures ANOVA revealed only a significant interaction effect between theory and group *F*(1, 143) = 24.986, *p* < .001. There were no other significant effects.

Simple effects tests using a Bonferroni correction were carried out on the two-way interaction between theory and group. Firstly, levels of agreement for dynamists were significantly higher when evaluating presentist scenarios (*M* = 5.45, *SD* = 1.45) relative to when evaluating B-theoretic scenarios (*M* = 4.76, *SD* = 1.38; *p* = .001). Secondly, levels of agreement for non-dynamists were significantly higher when evaluating B-theoretic scenarios (*M* = 5.59, *SD* = 1.39) relative to when evaluating presentist scenarios (*M* = 4.87, *SD* = 1.45; *p* < .001). Thirdly, for presentist scenarios, levels of agreement were significantly higher for dynamists relative to non-dynamists (*p* = .017). Finally, for B-theoretic worlds, levels of agreement were significantly higher for non-dynamists relative to dynamists (*p* < .001).

We might also capture this interaction effect by looking at the differences in the proportions of judgements about whether or not there is time, between dynamists and non-dynamists, for presentist and B-theoretic worlds. More specifically, using McNemar’s test, we can test whether a significant proportion of people come to change their judgment about whether or not there is time, when presented with a scenario describing a world which is not as they suppose the actual world to be.

For dynamists, the proportion of people who judge that there is *no* time is significantly greater when presented with B-theoretic worlds (χ2 (1) = 11.077, McNemar’s Test < .001). Likewise, for non-dynamists, the proportion of people who judge that there is *no* time is significantly greater when presented with presentist worlds (χ2 (1) = 18.750, McNemar’s Test <.001). While the proportion of people who judge that there is *no* time significantly increases when participants are presented with a world which is not as they suppose the actual world to be, there is no significant difference in this effect between dynamists and non-dynamists (χ2 (1) = 0.941, *p* = .332).

*3.3.2 Experiment Two Main Results*

Before reporting the statistics and details, let’s begin with a summary of our main findings from experiment two.

Once again, we predicted that we would find evidence in support of the shared sensitively-dynamical thesis. Thus we predicted that dynamists and non-dynamists would agree that if the actual scenario is non-dynamical then there is time (both actually and in a counterfactual dynamical scenario) but that if the actual scenario is dynamical then there is time actually, but not in a counterfactual non-dynamical scenario (the world-sensitivity part of the thesis). We once again found no evidence in support of this hypothesis. Which scenario participants were told is actual, had no statistical effect on their judgments about whether there was time in a counterfactual scenario.

Second, we predicted that dynamists and non-dynamists would agree that there is time in a dynamical scenario considered as actual, with no statistically significant difference between their levels of agreement. This prediction was partially supported. While in both groups a statistically significant majority judged that there is time in a dynamical scenario considered as actual, there was a statistically significant difference between the groups’ levels of agreement. Both groups gave larger judgments when evaluating a scenario that was most like they *in fact* take the actual world to be. So dynamists tended to give larger judgments when evaluating growing block scenarios, and non-dynamists tended to give larger judgments when evaluating B-theoretic scenarios.

Third, we predicted that both dynamists and non-dynamists will agree that there is no time in counterfactual a non-dynamical scenario, conditional on a dynamical scenario being actual, with no statistically significant difference between their levels of agreement, and that both dynamists and non-dynamists will agree that there is time in an actual non-dynamical scenario, and there will be no statistically significant difference between their levels of agreement. These predictions were only partially supported. Unlike experiment 1, we found that a significant majority of both dynamists and non-dynamists judge that there is time in all scenarios, both actual and counterfactual. Moreover, we find mean judgements significantly higher than 4 in all scenarios. There was also a statistically significant difference between these groups’ levels of agreement, as a result of participants’ larger judgments when evaluating a scenario that matched what they in fact think the actual world is like.

Moving on to the detailed statistics, of the original 350 participants, 141 participants correctly answered at least 2 of the 3 comprehension questions for *both* the dynamical and non-dynamical vignettes. The results outlined above, and presented below, include only these participants.

79 participants judged that the non-dynamical scenario was most like our world and 62 participants judged that the dynamical scenario was most like our world.[[13]](#footnote-13) There was no significant difference in confidence between non-dynamists (*M* = 5.09, *SD* = 1.54) and dynamists (*M* = 4.97, *SD* = 1.55; *t*(139) = 0.462, *p* = .645).

Table 3 reports levels of agreement to the sentence “There is time in Universe [B/E]”. Participants who chose 1-3 on the Likert scale are reported as disagreeing, while participants who chose 5-7 are reported as agreeing. Thus, weak agreement is reported as agreement in what follows.

*Table 3.* *Levels of agreement that there is time in worlds taken as actual or counterfactual. In parentheses, we note how the actual world is taken to be when making the judgement about the counterfactual world.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **%Yes** | **%No** | **%4** | **Mean** | **SD** | ***t*-value** | ***p*-value** |
| **Dynamists (*N* = 62)** |  |  |
| Actual Growing Block | 88.7 | 6.5 | 4.8 | 5.89 | 1.38 | 10.765 | <.001 |
| Counterfactual Growing Block (Actual B-Theory) | 85.5 | 11.3 | 3.2 | 5.71 | 1.43 | 9.413 | <.001 |
| Actual B-Theory | 69.3 | 24.2 | 6.5 | 5.08 | 1.73 | 4.918 | <.001 |
| Counterfactual B-Theory (Actual Growing Block) | 70.9 | 22.6 | 6.5 | 4.98 | 1.69 | 4.574 | <.001 |
| **Non-dynamists (*N* =79)** |  |  |
| Actual Growing Block | 74.7 | 17.7 | 7.6 | 5.41 | 1.65 | 7.557 | <.001 |
| Counterfactual Growing Block (Actual B-Theory) | 73.4 | 19 | 7.6 | 5.47 | 1.69 | 7.742 | <.001 |
| Actual B-Theory | 94.9 | 3.8 | 1.3 | 6.18 | 1.05 | 18.481 | <.001 |
| Counterfactual B-Theory (Actual Growing Block) | 83.6 | 13.9 | 2.5 | 5.71 | 1.50 | 10.160 | <.001 |

As in experiment one, the results of our t-tests (see Table 3 above) show that overall, dynamists and non-dynamists agree that there is time in *all* the scenarios that we tested. That is, overall, dynamists and non-dynamists agree that there is time in both growing block and B-theoretic worlds. However, unlike in experiment one, the results of our one-way χ2 tests (see Table 4 below) also show that the majority of dynamists and non-dynamists respond that there is time in *all* the scenarios that we tested. That is, the majority of dynamists and non-dynamists respond that there is time both in growing block and B-theoretic worlds, both actual and counterfactual.

*Table 4. Proportion of participants who responded that there was time in the scenario (Yes) and those who said that there was not (No) or who said that they neither agree nor disagreed that there was time.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **%Yes** | **%No/4** | **χ2** | ***p*-value** |
| **Dynamists (*N* = 62)** |
| Actual Growing Block | 88.7 | 11.3 | 37.161 | <.001 |
| Counterfactual Growing Block (Actual B-Theory) | 85.5 | 14.5 | 31.226 | <.001 |
| Actual B-Theory | 69.3 | 30.7 | 9.290 | .002 |
| Counterfactual B-Theory (Actual Growing Block) | 70.9 | 29.1 | 10.903 | .001 |
| **Non-dynamists (*N* =79)** |
| Actual Growing Block | 74.7 | 25.3 | 19.253 | <.001 |
| Counterfactual Growing Block (Actual B-Theory) | 73.4 | 26.6 | 17.329 | <.001 |
| Actual B-Theory | 94.9 | 5.1 | 63.810 | <.001 |
| Counterfactual B-Theory (Actual Growing Block) | 83.6 | 16.4 | 35.557 | <.001 |

Once again, in order to compare people’s responses across factors, levels of agreement were analysed using a repeated-measures ANOVA. The ANOVA included within-subjects factors of context (actual; counterfactual) and theory (growing block; B-theory) and a between-subjects factor of group (dynamists versus non-dynamists). The 2x2x2 repeated-measures ANOVA revealed only a significant interaction effect between theory and group (*F*(1, 139) = 26.008, *p* < .001). There were no other significant effects.

Simple effects tests using a Bonferroni correction were carried out on the two-way interaction between theory and group. Firstly, levels of agreement for dynamists were significantly higher when evaluating growing block scenarios (*M* = 5.80, *SD* = 1.35) relative to evaluating B-theoretic scenarios (*M* = 5.03, *SD* = 1.28; *p* < .001). Secondly, levels of agreement for non-dynamists were significantly higher when evaluating B-theoretic scenarios (*M* = 5.94, *SD* = 1.28) relative to when evaluating growing block scenarios (*M* = 5.44, *SD* = 1.36; *p* = .003). Thirdly, for growing block scenarios, there was no significant difference in levels of agreement between dynamists and non-dynamists (*p* = .118). Finally, for B-theoretic scenarios, levels of agreement were significantly higher for non-dynamists relative to dynamists (*p* < .001).

Finally, we can once again capture this interaction effect by looking at the differences in the proportions of judgements about whether or not there is time, between dynamists and non-dynamists for presentist and B-theoretic worlds. More specifically, we can test whether a significant proportion of people change their judgment about whether there is time or not, when presented with a world which differs from how they suppose the actual world to be.

For dynamists, the proportion of people who judge that there is *no* time is significantly greater when presented with B-theoretic worlds (χ2 (1) = 10.256, McNemar’s Test = .001). Likewise, for non-dynamists, the proportion of people who judge that there is *no* time is significantly greater when presented with growing block worlds (χ2 (1) = 16.000, McNemar’s Test < .001). While the proportion of people who judge that there is *no* time significantly increases when participants are presented with a world which is not as they suppose the actual world to be, there is no significant difference in this effect between dynamists and non-dynamists (χ2 (1) = 0.922), *p* = .337).

**4. Discussion**

There are two key findings from these studies. In what follows, since we largely see the same patterns of responses in both studies, we will for the most part talk about the results collectively.

The first key finding is that there was no evidence of sensitivity. We presented participants with dynamical and non-dynamical scenarios considered as actual, and also with those same scenarios considered as counterfactual, holding fixed that the actual world is of the other kind. Participants’ responses were not sensitive to whether the scenario was actual, or counterfactual and different from actuality. In turn, our hypothesis that we would find evidence of a shared sensitively-dynamical folk representation of time was not vindicated: for this is, of course, just one way of having a sensitive concept, something for which we found no evidence.

This data also suggests that the majority of participants do not deploy an insensitively-dynamical representation. For both dynamists and non-dynamists, in every condition of each study—even the non-dynamical conditions—the mean response was significantly greater than 4. In experiment two, a significant majority of both dynamists and non-dynamists judged there to be time in every scenario. The same was true of non-dynamists in experiment one. However, the dynamists in experiment one were split between saying there was time and either saying there was no time or being indifferent, when evaluating non-dynamical scenarios as actual or counterfactual. Nevertheless, we still found that in experiment one, more than half (61.5%) of those who in fact think our world is dynamical think that there is time in a counterfactual non-dynamical scenario, even when they are told that they are right about our world being dynamical.

Thus although Latham, et al. (2019) found that ~70% of participants represent *actual* time as dynamical, these results show that most dynamists employ neither an insensitively-dynamical nor a sensitively-dynamical, representation of time. So under neither disambiguation do dynamists represent time as being essentially dynamical. Nor do non-dynamists represent time as sensitively-dynamical. Hence, our prediction that dynamists and non-dynamists share a sensitive-dynamical representation, and simply disagree about whether actually, there are dynamical properties, was not vindicated.

In all, we found evidence against the shared representation thesis and in favour of the multi-representation thesis. First, our results suggest that most—but not all—participants have a directionally-sufficient representation. If participants employ that representation then they should judge that there is time in any scenario, dynamical or non-dynamical, regardless of whether it is considered as actual or counterfactual. That is what we found. This means that most people have a representation of time on which the presence of dynamical properties is sufficient, but not necessary, for there to be time, and the presence of non-dynamical yet temporally directed relations is also sufficient for there to be time.

Second, our results suggest that there are two smaller sub-populations who employ different representations of time. We found that some dynamists (32.2% in experiment one; 24.2% in experiment two) judge that if a non-dynamical scenario is actual, then actually, there is no time. This suggests that there is a small, but substantial, population of dynamists, who employ an insensitively-dynamical representation. Moreover, in both experiments, dynamists were significantly more likely to deny that there was time in non-dynamical scenarios versus in dynamical scenarios.

Equally, we found that some non-dynamists hold that if a dynamical scenario is actual, then actually there is no time (25% in experiment one; 17.7% in experiment two). This suggests that these non-dynamists employ a representation we did not consider prior to running these experiments, namely an insensitively-*non*-dynamical representation: i.e., one according to which only non-dynamical scenarios contain time, regardless of which scenario is actual. Moreover, in both experiments, non-dynamists were significantly more likely to deny that there was time in dynamical scenarios versus in non-dynamical scenarios.

Overall, then, the majority of the population employ a directionally-sufficient representation, and the remaining smaller population is divided into two: those who employ an insensitively-dynamical representation, and those who deploy an insensitively-*non*-dynamical representation.

That brings us to a second key finding. Although we found no evidence of sensitivity, we did find that what participants *in fact* think the actual world is like, has an effect on how they judge counterfactual scenarios, *regardless of which scenario they have been told is actual.* This is an intriguing finding. One possible explanation is that participants were unable entirely to shift their context of assessment to some scenario that is stipulated to be actual, where that scenario is not in fact how they suppose the actual world to be. Henceforth we will call this a failure properly to shift context.

If participants failed properly to shift context, then when non-dynamists were asked about counterfactual scenarios, conditional on a dynamical scenario being actual, they were still responding *as though* the actual scenario is non-dynamical, and likewise *mutatis mutandis* for dynamists. If so, then our data provides no evidence regarding the sensitivity or otherwise of the folk representation of time, since participants were always evaluating counterfactual scenarios from the perspective of the way they in fact take the actual world to be. There is some reason to suppose this might be so.

Consider first the dynamists. In experiment one, 60% of these participants think that a non-dynamical scenario, considered as actual, contains time. A very similar proportion (61.5%) think there is time in a counterfactual non-dynamical scenario, conditional on a dynamical scenario being actual. We find a very similar pattern in experiment two (69.3% and 70.9% respectively). This is surprising. Roughly the same percentage of dynamists think that there is time in a non-dynamical scenario considered as actual, as think there is time in a counterfactual non-dynamical scenario conditional on a dynamical scenario being actual. *Prima facie*, one would have expected more dynamists to judge that there is time in a non-dynamical actual scenario, than in a counterfactual non-dynamical scenario if a dynamical scenario is actual.

We find a similar pattern amongst non-dynamists. In experiment one, 70% of non-dynamists think there is time in a dynamical scenario considered as actual, while 68.7% think there is time in a counterfactual dynamical scenario, if a non-dynamical scenario is actual. We find the same pattern in experiment two (74.7% and 73.4% respectively).

This might be taken as evidence that dynamists are holding fixed that the actual world is as they in fact take it to be, i.e. dynamical, and evaluating any other scenario, whether they are told it is actual, or counterfactual, as if it were counterfactual. *Mutatis mutandis* for non-dynamists.

Although this pattern of responding is consistent with the hypothesis that participants are not properly shifting context, that is not the only potential explanation. If participants have an insensitive representation, and, in particular, if there are a number of different such insensitive representations in the population, then this is also the pattern we would expect: after all, an insensitive representation is one on which *it does not matter* whether one considers a scenario as actual, or counterfactual. So if people employ insensitive representations, we would also anticipate a pattern of responses that looks like this.

Is there, then, any independent evidence about people’s abilities that might give us reason to suppose they can (or cannot) properly shift context? There is some, limited, evidence we should consider. First, to take a bit of a step back, it’s worth noting that there is a good deal of evidence about people’s abilities to imagine scenarios: namely that in general they’re pretty good at it. More particularly, we know that while individuals’ capacity for imagination and simulation varies (see Carney, Wlodarski and Dunbar 2014) people are generally adept at imagining counterfactual scenarios.[[14]](#footnote-14) The capacity to do so is generally accepted to underwrite our capacity to engage in causal reasoning[[15]](#footnote-15) and in causal explanation,[[16]](#footnote-16) whereby we imagine what would have happened had we performed a certain intervention.

Often, of course, counterfactual reasoning requires that we suppose the world in question to be just as we take the actual world to be, except for the fact that the relevant intervention is performed. Equally though, such reasoning has been shown to play a role in our analyses and understanding of historical and political events, whereby we imagine, or simulate, how history would have been very different from the way it is, had some earlier even been different (Tetlock and Belkin 1996). This reflects a general capacity to imagine that things could have been very different indeed from how they in fact are. Moreover, we know that people are able to draw fairly fine distinctions between counterfactual scenarios. For instance, people’s judgements are sensitive to the difference between counterfactual *interventions* and counterfactual *observations* (Sloman 2005:77-78).

In addition, we know that future planning is based in part on our ability to construct mental models of the different ways things might go (Johnson-Laird 1983). On at least one way of thinking about how we do so, these different mental simulations are simulations of the ways things might go, for all we know: that is, they are simulations of what we might discover about the actual world, rather than imagined counterfactuals. That is to say, these are scenarios considered as actual. There is some evidence that this is indeed the right way to think about such cases. While there is neurophysiological evidence that episodic counterfactual thinking, episodic memory, and episodic ‘future’ thinking share common neural substrates—because people with impairment in one area typically show impairments across all three (see Hooker, Roese, and Park 2000)—there are noteworthy differences between episodic counterfactual thinking and episodic future thinking. For instance, episodic counterfactual thoughts are experienced with less emotional intensity than episodic future thoughts (De Brigard and Giovanello, 2012), and repeatedly simulating episodic counterfactual thinking tends to decrease its perceived plausibly, whereas repeating simulating episodic future thinking increases it (De Brigard, Szpunar and Schacter, 2013). This is at least consistent with the idea that some of these imaginings and simulations are simulations of counterfactual scenarios, and some as actual scenarios, and that we treat these simulations differently (or at least, that they have somewhat different broad effects on our psychologies).

A final piece of general evidence that is relevant here, is that experimental work strongly suggests that people understand counterfactual conditionals by imagining two possibilities, the actual world and the counterfactual alternative (Fillenbaum 1975; Thompson and Byrne 2002; Santamaría, Espino and Byrne 2005; De Vega, Urrutia and Riffo 2007). This suggests that counterfactual reasoning already involves holding fixed that a particular world (or scenario) is actual, and then imagining a counterfactual scenario that differs from the actual scenario in some way. This in turn suggests that we are able to keep in mind both a scenario considered as actual, *and* one considered as counterfactual, and indeed that our evaluation of counterfactuals is already tied to an assumption about which scenario is actual.

Of course, none of this shows that people are able properly to shift contexts in precisely the way demanded by our experimental design. To do so, participants must imagine that actually, things are other than they supposed, and then evaluate claims both at the actual scenario and at a counterfactual scenario.

There is, however, some evidence that people are able to do so. Within the literature on free will, experimentalists have been interested in whether or not non-philosophers have an incompatibilist concept of free will—that is, a concept that is not satisfied at any world that is deterministic—or a compatibilist one—a concept that is satisfied at (some) deterministic worlds.

Results of experimental work were initially rather puzzling. That is, because it seemed as though there was excellent evidence in favour of the non-philosophers’ concept of free will being a compatibilist concept (e.g., Nahmias, Mossis, Nadelhoofer and Turner, 2005; 2006), and also evidence in favour of it being a incompatibilist concept (e.g., Nichols and Knobe, 2007). For example, Nahmias et al. found that a majority of people judge that someone acts freely when presented with a scenario describing that someone’s action across numerous descriptions of our world being deterministic: the compatibilist response. Meanwhile, Nichols and Knobe found that majority of people, when presented with two hypothetical scenarios, one deterministic and one indeterministic, judge that our world is most like the indeterministic scenario. Furthermore, when asked whether people in the deterministic scenario are morally responsible (a proxy for free will) the majority of people judge that they are not: the incompatibilist response.

Reflection on differences in experimental set up (Roskies and Nichols 2008; Björnsson 2014; Latham 2019) identified a slight, yet important difference, which could explain the apparent conflicting results and show how they can be reconciled. While Nahmias et al. presented some of their scenarios as ones in which the actual world is described as being deterministic, Nichols and Knobe presented some of their scenarios as ones in which a hypothetical scenario is described as being deterministic. Roskies and Nichols found that people’s free will judgments when assessing a deterministic scenario differed significantly as a function of whether that scenario was described as actual, or as hypothetical (i.e. counterfactual). Participants who were assigned to make free will judgments when the deterministic scenario being evaluated was actual, were significantly more likely to agree that the scenario contained free will, than were those who were asked to evaluate the scenario as counterfactual.

Thus Latham (2019) presented people with an *indeterministic* scenario described as actual, and asked them to evaluate both that scenario, and a deterministic scenario described as counterfactual, and *vice versa.* Latham found that people’s responses to deterministic scenarios differed significantly as a function of whether there were evaluating the scenario as counterfactual or as actual. Specifically, people responded that indeterminism is only necessary for free will if it is actual, but if the actual world is deterministic, then determinism is compatible with free will. Hence Latham’s results suggest that our concept of free will is sensitive. Indeed, using the terminology of this paper we would say that the results suggest that the concept is sensitively-indeterministic.

If we take the results from Latham (2019) and Roskies and Nichols (2008) at face value and suppose that participants were able properly to shift contexts, then they, jointly, explain the previous incompatible and puzzling results regarding whether people have a compatibilist or incompatibilist concept of free will. In turn, this gives us some reason to think that in general, people are indeed able to shift contexts in the manner required by the experiment reported in this paper.

Having said that, there is room for caution here. While there is evidence that people can at least sometimes properly shift contexts, we grant that it might be harder when we are asking people to think about time. It might be, for instance, that imagining that we discover our world to be deterministic (when we think it indeterministic) is easier than imagining we discover our world to be non-dynamical when we think it dynamical, and *vice versa.* If that is so, then perhaps people’s representation of time is in fact sensitive, but we are failing to catch that sensitivity. In all though, we can conclude that our results suggest that people’s representations of time are insensitive, assuming they can properly shift contexts.

Even if participants cannot in fact properly shift contexts, we can still conclude that there is no evidence that people employ a representation of time that is essentially dynamical. For even amongst those who think that our world is, in fact, dynamical, most judge that there is time in a counterfactual non-dynamical world and *these* people are not being asked to shift their context to consider a world as actual, that is unlike what they in fact take our world to be like.

**5. Conclusion**

Our results show that arguments for temporal dynamism that proceed via a claim about the folk, or ordinary, view of time, must be carefully evaluated. Arguments that intend to show that there is defeasible reason to endorse a dynamical theory of the actual world because most people represent actual time as dynamical, are consistent with Latham, Miller and Norton’s (2019) results (though whether such arguments are good is another matter). By contrast, arguments that intend to show that dynamism is necessarily true because non-dynamism is conceptually impossible—because a non-dynamical world would not satisfy our representation of time—are not consistent with our results. These results suggest that the folk do not represent time as essentially dynamical.

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1. By a representation we just mean a contentful state that can be a constituent of thought. [↑](#footnote-ref-1)
2. Callender (2017) speaks of a naïve theory of time. [↑](#footnote-ref-2)
3. See Baron and Miller (2015a; 2015b). [↑](#footnote-ref-3)
4. Dynamists (or A-theorists) hold that events are ordered in terms of whether they are objectively past, present or future; the location of events within that ordering is dynamic in that a set of events, *E*, is future, will be present, and will then become past and this constitutes the flow of time. By contrast, non-dynamists deny that there are objective properties of pastness, presentness or futurity; all that exists is an ordering of events in terms of the relations of earlier-than, later-than and simultaneous-with, and hence there is no temporal flow. [↑](#footnote-ref-4)
5. Of course, there are many temporal dynamists who think that it is essential to time that it flows, but who do think that this is a conceptual necessity. It might simply be, as a matter of metaphysics, that the A-series is essential to time.

It is often unclear exactly what view different A-theorists take on this matter. For instance, Smith (1993), Gale (1968) Ludlow (1999) and Schlesinger (1982) think that we must posit an A-series because we cannot reduce A-theoretic talk to B-theoretic talk plus indexicals. If we think that our concept of time is intimately connected to our ways of talking about time and our position in it, then if A-theoretic talk is not reducible to B-theoretic talk, this might constitute its being conceptually necessary that time is dynamical. [↑](#footnote-ref-5)
6. See Baron, Cusbert, Farr, Kon, and Miller (2015). [↑](#footnote-ref-6)
7. For arguments of this kind see Zimmerman, (2008) Smith (1994), Craig (2000) and Schlesinger (1994). [↑](#footnote-ref-7)
8. For ways of discharging this burden see Ismael (2012); Callender (2017); Miller, Holcombe and Latham (2018). [↑](#footnote-ref-8)
9. Baron and Miller (2015a; 2015b) consider but do not defend this view. [↑](#footnote-ref-9)
10. Notably, the non-dynamical worlds we discuss are all worlds in which there is a direction of time. So by ‘non-dynamism’ in this paper we mean ‘non-dynamical yet temporally directed’. See Latham, Miller and Norton (2020) for discussion of whether people’s representation of time is sensitive to the presence or absence of temporal direction. [↑](#footnote-ref-10)
11. As such, scenarios need not describe genuinely possible worlds. So for instance, perhaps dynamical worlds are metaphysically impossible, and so a description of a dynamical scenario, considered as actual, is not the consideration, as actual, of a possible world. That is why we use the term ‘scenario’, rather than ‘world’. [↑](#footnote-ref-11)
12. Latham et al.’s (2019) experiment 1 found that 14.5% chose the moving spotlight theory, 17.4% chose presentism, 34.3% chose the growing block, 17.2% chose the block universe, 9.3% chose the C-theory and 7.3% chose Quantum Gravity, as being most like our universe. For our minimally modified vignettes, we found that 14.3% chose the moving spotlight theory, 22.7% chose presentism, 17.6% chose the growing block, 27.5% chose the block universe, 12% chose the C-theory and 4.9% chose Quantum Gravity as being most like our universe. While this distribution is not exactly the same as theirs, it is close enough. 600 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated $2 for approximately 20 minutes of their time. 56 participants had to be excluded for failing to follow task instructions. This means that they failed to answer the questions (47), or failed an attentional check question (9). The remaining sample was composed of 544 participants (aged 19-70; 226 female; 1 prefer not to answer). Mean age 36.61 (*SD* = 10.81). 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. [↑](#footnote-ref-12)
13. It is notable that a majority of participants (we did not test this for significance) judged that the eternalist B-theoretic scenario was more like the actual world than the growing block scenario, given that Latham et al. (2019) found the growing block theory to be the most popular theory of time. As per a helpful suggestion from an anonymous referee, we suspect that this effect is in part due to the time-neutral rendering of the vignettes, which lowered the popularity of the growing block while bolstering the popularity of the B-theoretic eternalist view. We are optimistic that this has not led to any substantial misclassification of participants. Firstly, we only gathered data from participants who passed comprehension checks for both vignettes. Secondly, while our time-neutral replication of Latham et al.’s study roughly halved the popularity of the growing block from Latham et al.’s experiment 1 (from ~34% down to ~17%), only ~24% of participants chose the growing block in Latham et al.’s experiment 2 (which was a replication of their first experiment). [↑](#footnote-ref-13)
14. Impairment in counterfactual thoughts can occur after sustained damage to the prefrontal cortex (e.g.,

Beldarrain, Garcia-Monco, Astigarraga, Gonzalez and Grafman, 2005 and Knight and Grabowecky, 1995) or from other causes such as Parkinson’s disease, and has been shown to have far reaching consequences for people’s capacity to understand intentions and make decisions, and also for their experience of certain emotions such as regret, and the accuracy of their social attributions such as blame and responsibility (Beldarrain et al. 2005; Roese, Park, Smallman and Gibson, 2008). [↑](#footnote-ref-14)
15. See Gopnik, Glymour, Sobel, Schulz, Kushnir, and Danks (2004), Kushnir, Gopnik, Lucas and Schultz (2010), Lagnado and Sloman (2004), Steyvers, Tenenbaum, Wagenmakers and Blum, (2003) and Sloman (2005). [↑](#footnote-ref-15)
16. See Einhorn and Hogarth (1986). Indeed, interventionist accounts of what causation *is* have been proposed by Pearl (2000), Woodward (2003) and Menzies (2007), among others. As Woodward (2003:11) puts it: “one ought to be able to associate with any successful explanation a hypothetical or counterfactual experiment that shows us that and how manipulation of the factors mentioned in the explanation (the *explanans*, as philosophers call it) would be a way of manipulating or altering the phenomenon explained (the *explanandum*). Put in still another way, an explanation ought to be such that it can be used to answer what I call a *what‐if‐things‐had‐been‐different* *question*: the explanation must enable us to see what sort of difference it would have made for the explanandum if the factors cited in the explanans had been different in various possible ways.” [↑](#footnote-ref-16)