EPISODIC IMAGINING, TEMPORAL EXPERIENCE, AND BELIEFS ABOUT TIME

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Abstract

We explore the role of episodic imagining in explaining why people both differentially report that it seems to them in experience as though time robustly passes, and why they differentially report that they believe that time does in fact robustly pass. We empirically investigate two hypotheses, the differential vividness hypothesis, and the mental time travel hypothesis. According to each of these, the degree to which people vividly episodically imagine past/future states of affairs influences their tendency to report that it seems to them as though time robustly passes and to judge that time does robustly pass. According to the former, a greater degree of vividness will tend to *increase* the extent to which people make such reports, while according to the latter, it will tend to *decrease* the extent to which people make such reports. We found weak evidence in favour of the former hypothesis. We reflect on the implications of this finding for theorising about such reports.

1. Introduction

Call a world *dynamical* if time robustly[[1]](#footnote-1) passes in the manner posited by A-theorists,[[2]](#footnote-2) such that there is some objective fact of the matter as to which events are present, and such that which events those are, changes as time passes. Call a world *non-dynamical* if it does not contain robust passage such that past, present, and future have no special metaphysical status but rather are merely relative or perspectival: what is past relative to one event is future relative to another, [[3]](#footnote-3) and either does contain static B-relations of earlier-than, later-than, and simultaneous-with,[[4]](#footnote-4) or contains C-relations (temporal between-ness relations).[[5]](#footnote-5)

Many people believe that time robustly passes, in the sense that they will judge that a description of a dynamical world is closer to the way our world is than is a description of a non-dynamical world (e.g., Graziani, Orilia, Capitani and Burro 2023; Latham, Miller and Norton 2019, 2020a, 2021; Latham, Miller, Tarsney and Tierney 2021; Hodroj, Latham, Lee-Tory and Miller 2023; Baron, Everett, Latham, Miller, Tierney and Oh 2023). Latham Miller and Norton (2019, 2020a, 2021) found that ~70% of people believe that time robustlypasses. More recently, Hodroj, Latham, Lee-Tory and Miller (2023) found that ~65% of people have this belief, while Baron, Everett, Latham, Miller, Tierney and Oh (2023), probing people’s beliefs using animated diagrams rather than vignettes, found that ~75% have this belief. This pattern of reported beliefs demands an explanation: why do roughly 70% of people believe that time robustly passes, while 30% believe that time does not robustly pass? Call this the *belief explanandum.*

Many people also report that it seems to them, in experience, as though time robustly passes. Here, we take the ‘in experience’ to pick out a perceptual, or at least quasi-perceptual experience in which it perceptually or quasi-perceptually seems as though time robustly passes or at least, in which people report that this is how it seems. In this we follow Paul (2010), Le Poidevin (2007), Dainton (2011, 2012) and Miller (2022). (We will also sometimes put this in terms of people having a certain *temporal phenomenology,* one which they are inclined to describe as being a phenomenology *as of* time robustly passing)[[6]](#footnote-6). We know that ~40% of people *strongly* agree that it seems to them as though time robustly passes and ~60% at least *weakly* agree that it seems this way, leaving ~40% of people who do not even weakly agree that it seems this way (Latham, Miller and Norton 2020b, Shardlow, Lee, Hoerl, McCormack, Burns and Fernandes 2020). This data also calls out for explanation. We want to know why there is this variation in reports. Call this the *experiential explanandum*.

Thus, some explanation is needed of why we find the variation we do when it comes to reported experiences of, and beliefs about, time’s robust passage. That is so regardless of which view we take regarding the nature of time and our experiences thereof. Passage realists think that there is robust passage and that we have veridical experiences of it.[[7]](#footnote-7) Passage illusionists think there is no robust passage, but that we have illusory experiences as of robust passage.[[8]](#footnote-8) Passage deflationists think there is no robust passage and that we have veridical experiences of some other aspect of temporal structure and hence do not have experiences as of robust passage.[[9]](#footnote-9) (Though deflationists sometimes hold that we believe that this is what our experiences are like[[10]](#footnote-10) or at the very least that this is how we report our experiences to be[[11]](#footnote-11)). Regardless of which view of this one takes on this matter, some explanation is needed of why we find such variation in what people report regarding their experiences and, in turn, their beliefs.

Several candidate explanations have been offered in the literature. In principle, each of these can be offered by passage realists, illusionists, or deflationists, though some may be more amenable to some views than are others.

According to the *open-future explanation,* differences regarding whether we represent the future as open, and the past closed, explain variation in reported beliefs about, and experiences as of, time robustly passing (Ismael 2012, 2017; Prosser 2016; Hodroj, Latham, Lee-Tory and Miller 2022). According to this view, people differentially represent the past as objectively fixed and the future as objectively open*.* People who represent the future as objectively open represent *more* states of affairs as closed, and *fewer* states of affairs as open at later times than at earlier times, and thus represent a change in which states of affairs are objectively open and which are objectively closed. As such, then tend to come to represent there being a privileged moment that stands ‘between’ the open and the closed states of affairs, and that which moment that is, changes as states of affairs that were open, become closed. Then according to this view, those people then come to tend to believe that time robustly passes, and then to interpret their experiences in those terms, and hence to report that this is how things seem to them (Hodroj, Latham and Miller ms; Hodroj, Latham, Lee-Tory and Miller 2023; Latham and Miller 2023; Bigg, Latham, Miller and Yechimovitz ms).

Several studies have probed whether people who report believing that time robustly passes also tend to be more likely to report that the future is open in one way or another (Hodroj, Latham and Miller ms; Hodroj, Latham, Lee-Tory and Miller 2023; Latham and Miller 2023). However, these studies found no evidence of an association between people’s beliefs about the objective openness of the future and their beliefs about time robustly passing. So, at least as regards the belief explanandum, such explanations do not enjoy empirical support.

A second candidate explanation is *the* *agentive explanation*. According to this view, people differentially experience themselves agentively, and the greater the degree to which people experience themselves as agents the more inclined they are to report that it seems as though time robustly passes (Young 2022; Bigg, Latham, Miller and Yechimovitz ms). There are several versions of the agentive explanation. According to one version, people’s experience of agency is *misdescribed* as being an experience as of robust passage, so that the more strongly someone has that experience, the more likely they are to report that it seems to them as though time robustly passes. According to another version, the stronger the experience of agency, the more likely people are to *misinterpret* their temporal experiences in such a way that they come to describe them as being as of robust passage (Bigg, Latham, Miller and Yechimovitz (ms)).

A recent study by Bigg, Latham, Miller and Yechimovitz (ms) found some support for the agentive explanation. They found that higher scores on the sense of agency scale were associated with reporting that it seems as though time robustly passes, though they were not associated with believing that time robustly passes. This suggests that, at least as regards the experiential explanandum, some version of the agentive explanation may be correct at least as a partial explanation of people’s differential reports regarding its seeming as though time robustly passes. However, Bigg, Latham, Miller and Yechimovitz (ms) suggest that it is likely that other factors also play a role in explaining these differential reports.

Another candidate explanation for these differential reports appeals to the idea that the extent to which people vividly episodically imagine past/future states of affairs influences the extent to which they report that it seems to them in experience as though time robustly passes, and the extent to which they judge that time does in fact robustly pass. When we talk about how vividly someone imagines a state of affairs, we mean the extent to which they imagine that state of affairs in detail. So, for instance, at one end of the spectrum an individual imagines a state of affairs in a very vivid manner if that state of affairs, as it is presented in imagination, has all or most of the details that it would have, were the individual to be experiencing that state of affairs in the present. At the other end of the spectrum an individual imagines a state of affairs with very little vividness if that state of affairs, as it is imagined, has very few of the details that it would have, were that individual to be experiencing that state of affairs in the present. When the details of the state of affairs to be imagined include emotionally salient details, then the more vividly the state of affairs is imagined, the more emotionally salient it will be. However, emotional salience can come apart from vividness, since there can be states of affairs which, even which imagined vividly, are not emotionally salient (such as, for instance, vividly imaging buttering some bread).

As we see it, there are two ways in which differential vividness might influence people’s reports regarding the experience of temporal passage and, in light of that their beliefs about robust passage.

The first of these is that a greater capacity to imagine more vividly, past and future episodic events may be associated with a greater tendency to report experiencing time as robustly passing, and, in turn, associated with a greater tendency to report believing that time robustly passes.

This hypothesis is motivated by the idea that there is reason to think that the degree to which people report that future events feel as though they are approaching, and past ones receding, is influenced by the emotional intensity of those imagined events. We know that future episodic imagining (both of events that will happen and of counterfactual ones) tends to evoke more emotional intensity that does the episodic imagining of past events (Caruso, Gilbert & Wilson (2008); Caruso (2010); D’Argembeau & Van der Linden (2004); Van Boven & Ashworth (2007). Furthermore, future events are often reported as feeling subjectively closer in time than are equidistant past events (Caruso, Van Boven, Chin & Ward (2013)).

Given this, we can hypothesise that it is in part because future events are more emotionally salient that they are reported as *feeling closer*. Then it may be that the extent to which people report that future events are approaching, and past ones receding, is in part a function of the extent to which people report that those events feel differentially closer/further away. If so, then it is plausible that the more emotionally salient an event is, the more people will report that it seems as though it is approaching when it is future and receding when it is past.

Moreover, the idea that there is a connection between emotional salience and reporting that future events are approaching and past ones receding, has an independent ring of plausibility to it. Consider a painful dental procedure. It seems plausible that it is in part the fact that in imagining the dental procedure as future we imagine something that is highly negatively valenced, that we report that the dreaded event feels like it is coming towards us. Likewise, once the dental procedure is in the past, it is in part because the salience of the negatively valenced event is reduced that we report being relieved that it is over and done with. This kind of relief might in turn partially explain why we report that the procedure is receding ever further away. By contrast, consider some event that has no emotional valence at all. Now imagine that event as future, or as past. Because that event is much less emotionally arousing, we may be significantly less inclined to report that it seems to be either moving towards or away from us.

If that is right, then we would expect that a greater capacity for vivid episodic imagination will tend to be associated with reporting that time robustly passes and, in turn, with coming to believe that time robustly passes. Call these the *differential vividness hypotheses.*

The Differential Vividness Hypotheses:

H1: A greater capacity for vivid episodic imagining will be associated with a greater tendency to report that it seems as though time robustly passes.

H2: A greater capacity for vivid episodic imagining will be associated with a greater tendency to report that time robustly passes.

By contrast, one might think that the capacity for vivid episodic imagining influences the extent to which people report that it seems to them as though time robustly passes, and in turn the extent to which they believe that time robustly passes, but that this influence is in the opposite direction to that posited by the differential vividness hypotheses.

There are a couple of reasons to suppose this to be so. First, it may be that the more vividly someone can imagine non-present events, the more these events will seem ontologically on a par with present events. In turn, one might expect that the more non-present events seem ontologically on a par with present events, the more likely it is that people will not report that it seems to them as though time robustly passes.[[12]](#footnote-12)

Second, we have fewer degrees of freedom of movement in time than we do in space. Each of us can, for the most part, move in any direction along the three spatial dimensions. We can move up and down, left and right, back and forth. Because of this freedom of movement each of us can perceive the same state of affairs from multiple different spatial perspectives. In contrast, we at least seem to have far fewer degrees of movement along the temporal dimension. We cannot choose to ‘move’ backwards in time. If time is a dimension, then it is one that permits us only one direction of ‘travel’. In turn, we cannot perceive states of affairs from anything other than a single temporal perspective; the one we in fact inhabit (Hoerl 2018).

We also have, or at least seem to have, no compulsion to move in space. We can “stand still” in space, occupying the same spatial location for a period of time.[[13]](#footnote-13) We are not *compelled* to occupy a series of distinct spatial locations. Thus, each of us can perceive the same state of affairs from the same spatial vantage point at different times. In contrast, we are, or at least seem to be, compelled to move in time. We cannot *stay put* at a single temporal instant. Moreover, not only are we compelled to move in time, but we are compelled to move in a particular temporal direction: we are compelled to occupy progressively later times.

Differences in freedom of movement might at least partially explain why people are more inclined to report that it seems to them, in *experience*, as though time but not space has a direction and, in turn, why people are more inclined to *believe* that time, but not space, has a direction. If it seems to us, in experience, that we can only move in one direction in time, but can move in multiple directions in space, then it is likely that it will seem to us, in experience, as though time but not space has a direction. If it seems to people, in experience, as though time but not space has a direction, then it is plausible that people will come to believe that time, but not space, has a direction.

This, in conjunction with differences in freedom from compulsory movement might, then, partly explain why people are more inclined to report that it seems to them in experience as though time robustly passes but space does not, and why they tend to believe that time robustly passes but, again, space does not. If it seems to people, in experience, as though time has a direction (as per differences in degree of freedom) but space does not, and if it seems to people as though they are compelled to move from earlier to later times, but not compelled to move anywhere in space, then they will be more inclined to report that it seems as though time, but not space, robustly passes. In turn, it is plausible that based on these experiences people will tend to come to believe that time, but not space, robustly passes.

However, it might seem that appealing to these two features will be of little use in explaining variations in reported experiences of, and beliefs about, time’s robust passage. After all, one might expect there to be little variation in the extent to which people experience themselves as lacking freedom of movement in time, or the being compelled to move in time. One possibility is that the extent to which people can *mentally time travel* influences their experience of a lack of freedom of temporal movement, and hence influences the extent to which they report that they experience time as robustly passing, and the extent to which they come to believe that time robustly passes.

Mental time travel is the capacity to recall past autobiographical events and to imagine possible future events (Tulving 2002). More carefully, it’s the ability to episodically remember past events and to imagine future events. Episodic memories are memories from our life events and experiences, and involve the ability to retrieve detailed information about these personal experiences. Episodic memories are to be contrasted with semantic memories, which are just factual and conceptual knowledge of the world.

Although there exists some ambiguity in the literature regarding whether the defining feature of mental time travel is the *cognitive faculty* which undergirds the capacity to construct such experiences (Suddendorf and Corballis, 2007), or else the *conscious awareness* one has when reconstructing said experiences (Gardiner, 2001), we will use “mental time travel” to refer simply to the ability to generate such reconstructions, without any prejudice pertaining to these more definitional questions.[[14]](#footnote-14)

Mental time travel is typically thought to involve a capacity to represent the when, where, and what, of some past or future event or state of affairs. It is often also thought to involve a certain imaginative acquaintance with those events, and to involve a distinctive phenomenology of experiencing those episodes *as past* or *as future*. Understood in this way, mental time travel involves the capacity to ‘pick oneself’ up from one’s current temporal location and locate oneself at another time and to experience the events of that time as if one is there, whilst at the same time representing that those events are past or future from one’s actual location.

Importantly, there is the strong likelihood that a single cognitive mechanism underlies *both* mental time travel to the past (episodic memory) *and* mental time travel to the future (episodic future imaginings). [[15]](#footnote-15) The most appealed to evidence in this regard consists of observations of patients with trauma induced damage to episodic memory (pastward mental time travel).[[16]](#footnote-16) In these cases, patients exhibiting damage to the medial temporal lobe, or suffering from anoxic encephalopathy are observed to have severely compromised episodic memory *and* future directed episodic imaginations, whilst nevertheless retaining functional *semantic* memory, indicating a unified cognitive mechanism subserving mental time travel in both directions, and one independent of merely semantic recollection abilities. This outcome has been further supported by direct examination of brain function during both past directed, and future directed mental time travel (Okuda et al. 2003), consolidating the view that thinking about the past and imagining the future engages a common core brain network (Schacter, Addis, & Buckner, 2007).”[[17]](#footnote-17)

There is reason to think that there may be a connection between mental time travel and reported temporal experience quite broadly. We know that individuals with depression tend to experience temporal disturbances, including tending to report a decrease in the subjective *speed* of the flow of time (e.g, Blewet 1992; Bschor et al. 2004; Mundt et al. 1998; Richter and Benzenhoefer 1985; Wyrick and Wyrick 1977; for recent meta-analysis see Thönes and Oberfeld 2015).[[18]](#footnote-18) We also know that people suffering depressive disorders tend to be less able to episodically future mentally time travel (e.g., Beck 1974 Miloyan et al 2014). Similar findings have been made amongst individuals with schizophrenia and individual who score high on schizotypy (for discussion see Baron, Latham and Varga 2023). This suggests that perhaps the capacity to mentally time travel plays a role in how people experience, or report experiencing, time.

One more specific hypothesis is that people who show a greater capacity for mental time travel will tend to experience themselves less intensely as having fewer degrees of freedom along the temporal dimension and as being less compelled to move ‘with time’ than those with a lesser capacity for mental time travel. After all, mental time travel, at least in some sense, involves ‘unfixing’ oneself from the current moment and taking the perspective of times that are either earlier, or later, than the current moment insofar as it involves episodically imagining certain events both (a) from the first personal perspective and (b) imagining then *as past,* or *as future.* As such, we might expect that people with a greater capacity to mentally time travel will tend to experience themselves as being less ‘stuck’ in time with fewer degrees of movement, and as less pushed to move in time in a single direction from past to future. Thus, what we might call the *mental time travel hypotheses* says that a greater capacity for mental time travel will be associated with a lower tendency to report that it seems as though time robustly passes, and a lower tendency to report that time robustly passes.

Since the capacity to mentally time travel crucially depends on the capacity for episodic memory and episodic future imagining, if the mental time travel hypotheses are correct, then we should find the following:

H3: A greater capacity for vivid episodic imagining will be associated with a lesser tendency to report that it seems as though time robustly passes.

H4: A greater capacity for vivid episodic imagining will be associated with a lesser tendency to report that time robustly passes.

In this paper we explore both the differential vividness hypothesis and the mental time travel hypothesis by investigating H1 through H4. We begin, in Section 2 by outlining our methodology and results, before in Section 3 discussing the implications of those results for theorising about the experiential and belief explananda.

**2. Methodology and Results**

**2.1 Method**

*2.1.1 Participants*

599 people participated in the study. Participants were U.S. residents, recruited and tested online using Prolific, and compensated £2.7 for approximately 17 minutes of their time. 428 participants were excluded from the analyses for failing to correctly answer *all* comprehension and attentional check questions. The remaining sample was composed of 171 participants (aged 21-99, M = 39.67, SD = 14.08; 74 female, 6 trans or non-binary). 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.

*2.1.2 Materials and Procedure*

Our experimental methods and materials are adapted from those used by Hollis-Hansen, O’Donnell, Seidman, Brand and Epstein (2019), and Halford et al (2019).

Participants were divided into three groups: future, past and control. Participants in the future group were asked to identify a future event which they could vividly imagine happening or that they were planning to do: one day, three days, and seven days from that day (e.g. a family vacation, professional conference, doctor appointment, birthday party etc.) three events in total. Participants in the past groups were asked to do the same, but for events that really occurred one day, three days and seven days before that day.

Participants were presented with their events of choice in randomized order and were asked to describe and rate each of them. They were directed to describe the events in as much detail as possible (e.g., where it happens, who would be there, what would happen, how you might feel, what you might think etc.) There was no length limitation, and they were told they could take as long required (though within the time limit for the entire survey as set by Prolific). With the cue they created still in front of them, they were then asked to rate how vivid the event was in their mind, and how pleasant the event was in their mind, on a Likert scale from 1 (not at all) to 7 (very vivid/very pleasant.

Participants in the control group were asked to pick three different activities which they could have been doing instead of taking a survey. They were instructed to pick an activity they would normally do and is part of their routine (e.g., driving to work, brushing your teeth, playing a game on your phone, exercising, etc.).

Just as in the future and past groups, participants in the control group were then presented with each of their chosen activities in randomized order and asked to describe each activity in detail and then rate them in terms of vividness and pleasantness.

In order to determine whether people report that it seems to them as though time passes, we presented participants with both moving ego and moving time expressions, drawn from Latham, Miller and Norton (2020). We assume, alongside Latham, Miller and Norton (2020) and Shardlow, Lee, Hoerl, McCormack, Burns and Fernandes (2020) that insofar as people report agreement to its seeming as though things are as expressed by moving time expressions, that they are reporting that it seems to them as though time robustly passes. It remains unclear whether reporting agreement to its seeming as though things are as expressed by moving ego expressions also counts as reporting that it seems as though time robustly passes. However, we think it is important to capture data regarding both sets of expressions precisely because this is unclear.

Participants see these expressions (in randomized order) and respond, on a Likert scale from 1 (strongly disagree) to 7 (strongly agree).

**Moving Time Expressions**

1. It feels to me like the present moves.
2. It feels like the events of tomorrow are moving towards me.
3. It feels like the events of yesterday are moving away from me.

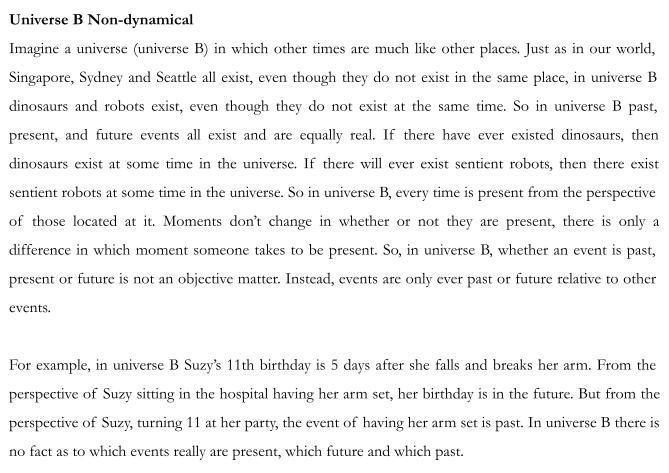
**Moving Ego Expressions**

1. It feels like I am moving through time.
2. It feels like I am moving towards the events of tomorrow.
3. It feels like I am moving away from the events of yesterday.

Finally, to determine what it is that people believe about whether our world is dynamical or non-dynamical we then presented participants with two vignettes, one which described a dynamical world, and the other a non-dynamical world, and participants were asked which they think is most like our world. We take people reporting that the non-dynamical world is most like our world to constitute people having an at least tacit belief that our world is non-dynamical, and mutatis mutandis for reporting that the dynamical world is most like our world.

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We can now be a little more precise in stating both the differential vividness hypotheses and the mental time travel hypotheses.

Differential Vividness Hypotheses

H1: There will be an association between higher scores on the past and future episodic thinking task and higher scores on the moving time and moving ego expressions.

H2: There will be an association between higher scores on the past and future episodic thinking tasks and judging that the dynamical world is more like our world, and between lower scores on the past and future episodic thinking tasks and judging that the static world is more like our world.

Mental Time Travel Hypotheses

H3: There will be an association between higher scores on the past and future episodic thinking task and lower scores on the moving time and moving ego expressions.

H4: There will be an association between higher scores on the past and future episodic thinking tasks and judging that the static world is more like our world, and between lower scores on the past and future episodic thinking tasks and judging that the dynamical world is more like our world.

2.2 Results

Before reporting our results, we will first summarize them with respect to each of our hypotheses. First, we predicted that there would be an association between higher scores on the past and future episodic thinking task and higher/lower judgments on the moving time and moving ego expressions. These were H1 of the Differential Vividness Hypotheses and H3 of the Mental Time Travel Hypotheses. We observed a negligible association between vividness scores and moving time judgments for participants in the past and future conditions of the episodic thinking task. Next, we predicted that there would be an association between higher scores in the past and future conditions of the episodic thinking task and judging that the dynamical/static world is more like our world. These were H2 of the Differential Vividness Hypothesis and H4 of the Mental Time Travel Hypothesis. Neither of these hypotheses were vindicated. There was no association between vividness scores, and which world participants judged to be most like our own.

Table 1 below shows participants’ vividness and pleasantness scores to the events which they imagined between those assigned to the past and future episodic thinking task and those assigned to the present episodic thinking task. It also shows participants’ judgments to the moving time and moving ego expressions between those tasks. The ‘Vividness’, ‘Pleasantness’, ‘Moving Time’ and ‘Moving Ego’ rows show the average vividness and pleasantness scores across the three events which participants imagined, and the average level of agreement to the three moving time and moving ego expressions.

*Table 1.* *People’s vividness and pleasantness scores and moving time and moving ego expression judgments between those assigned to the past and future episodic thinking task and present episodic thinking task*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Past and Future Episodic Thinking**  **(n = 99)** | | **Present Episodic Thinking**  **(n = 72)** | |
|  | **M** | **SD** | **M** | **SD** |
| **Vividness** | **5.68** | **1.11** | 5.97 | 0.90 |
| Event One | 5.76 | 1.26 | 6.06 | 1.03 |
| Event Two | 5.61 | 1.41 | 5.92 | 1.07 |
| Event Three | 5.68 | 1.34 | 5.94 | 1.06 |
| **Pleasantness** | 5.17 | 1.26 | 5.63 | 1.07 |
| Event One | 5.14 | 1.73 | 5.85 | 1.38 |
| Event Two | 5.14 | 1.83 | 5.56 | 1.41 |
| Event Three | 5.23 | 1.87 | 5.50 | 1.43 |
| **Moving Time** | **4.53** | **1.38** | 4.71 | 1.43 |
| Present Moves | 4.36 | 1.78 | 4.50 | 1.76 |
| Event Towards | 4.78 | 1.69 | 4.89 | 1.71 |
| Event Away | 4.43 | 1.69 | 4.75 | 1.69 |
| **Moving Ego** | **4.86** | **1.37** | 5.22 | 1.39 |
| I Move | 4.65 | 1.78 | 5.06 | 1.74 |
| I Towards | 5.15 | 1.49 | 5.31 | 1.54 |
| I Away | 4.78 | 1.61 | 5.29 | 1.35 |

To examine the association between participants’ scores in each of the episodic thinking task and moving time and moving ego expressions we calculated separate Spearman’s Rho correlation coefficients. Table 2 below displays these coefficient values.

*Table 2.* *Spearman’s Rho correlation coefficients between people’s vividness and pleasantness scores and moving time and moving ego expression judgments across both the past and future episodic thinking task and present episodic thinking task*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Past and Future Episodic Thinking Task** | | | | |
|  | **Vividness** | **Pleasantness** | **Moving Time** | **Moving Ego** |
| **Vividness** | - |  |  |  |
| **Pleasantness** | .436\*\* | - |  |  |
| **Moving Time** | .206\* | .246\* | - |  |
| **Moving Ego** | .175 | .097 | .699\*\* | - |
| **Present Episodic Thinking Task** | | | | |
| **Vividness** | - |  |  |  |
| **Pleasantness** | .399\*\* | - |  |  |
| **Moving Time** | .203 | .220 | - |  |
| **Moving Ego** | .390\*\* | .260\* | .574\*\* | - |

N.B. \**p*<.05 and \*\**p*<.001

Beginning with vividness, for those participants in the past and future conditions of the episodic thinking task, we observed only a weak positive correlation between moving time judgments and vividness scores (*p* = .041). In contrast, for those participants in the present episodic thinking task we observed a moderate positive correlation between moving ego judgments and vividness scores (*p* < .001).

Next, looking at pleasantness. For those participants in the past and future episodic thinking task we observed only a weak positive correlation between moving time judgments and pleasantness scores (*p* = .014). For those participants in the present episodic thinking task, we observed only a weak positive correlation between moving ego judgments and pleasantness scores (*p* = .028).

Across both the past and future episodic thinking task and present episodic thinking task there was a moderate positive correlation between vividness and pleasantness scores (*p* < .001). There was also either a strong positive correlation (past and future episodic thinking task, *p* < .001)) or a moderate positive correlation observed between participant’s moving time and moving ego judgments (present episodic thinking task, *p* < .001).

We were also interested in exploring the association between people’s vividness and pleasantness scores and, moving time and moving ego judgments, irrespective of the task they were assigned to perform. We observed only a weak positive correlation between people’s vividness scores and moving time judgments, *r*(169) = .207, *p* = .007, and between their vividness scores and moving ego judgments, *r*(169) = .272, *p* < .001. Similarly, we observed only a weak positive correlation between people’s pleasantness scores and moving time judgments, *r*(169) = .235, *p* = .002, and a negligible correlation between their pleasantness scores and moving ego judgments, *r*(169) = .180, *p* = .019. We also continued to observe a moderate positive correlation between participant’s vividness and pleasantness scores, *r*(169) = .432, *p* < .001, and a strong positive correlation between moving time and moving ego judgements, *r*(169) = .650, *p* < .001.

Finally, to determine whether there was an association between participant scores on the past and future episodic thinking task and judging that the dynamical or static world is more like our own we ran separate between-subjects t-tests for vividness and pleasantness scores. There was no significant difference in vividness scores between participants who thought our world is more like the dynamical world (M = 5.81, SD = 1.00) and those who thought our world is more like the static world (M = 5.80, SD = 1.10; *t*(169) = .050, *p* = .960). Nor was there any significant difference in pleasantness scores between those who thought our world is more like the dynamical world (M = 5.37, SD = 1.20) and those who thought it is more like the static world (M = 5.36, SD = 1.22; *t*(169) = .091, *p* = .927).

3. Discussion

There are several notable aspects of our results. First, consider the fact that we presented participants with both moving time and moving ego expressions. There are several views you might have about what it is that people are expressing when they report agreement to moving time or moving ego expressions.

First, you might take the view that there are two distinct temporal phenomenologies, one of which (many) people describe using moving time expressions, and the other of which (many) people describe using moving ego expressions. Call this *the dual phenomenologies* *view.*

An alternative view is that there is a single temporal phenomenology that people *either* describe by using moving time expressions or describe by using moving ego expressions, but not both. Call this the *single phenomenology single description view.* On this view these two kinds of expressions are two ways of describing the same temporal phenomenology, but people will describe that phenomenology using only one kind of expression.

Finally, it might be that there is a single temporal phenomenology that (many) people will describe using *both* moving time expressions and moving ego expressions. On this view these two kinds of expressions are two ways of describing the same temporal phenomenology, and people will use either sort of expression. Call this the *single phenomenology multi-description view.*

Our results tend to speak against the single phenomenology single description view. We found a strong association between moving time and moving ego judgements, suggesting that (many) people will describe their experience using *both* set of expressions. This tends to rule out the single phenomenology single description view. Our results are, however, consistent with there being two distinct phenomenologies, one on which it seems as though the ego moves, and one in which it seems as though time moves, such that these phenomenologies are typically associated and hence people tend to agree *both* that it seems as though the ego moves and as though time moves. On this view, it seems to people both as though they are moving towards future events and away from past ones, and also as though future events are moving towards them, and past events are moving away from them. Our results are also consistent with there being a single phenomenology, which (many) people are equally inclined to report using either moving time or moving expressions. This could be a dynamical phenomenology, which is equally well captured by either moving time or moving ego expressions, or it could be a phenomenology that is not dynamical, but which many people describe using these kinds of dynamical expressions. Our results are compatible with any of these views. One might argue that the idea that there is a single phenomenology (whether dynamical or not) that is described in two ways, rather than two distinct phenomenologies, is the simpler view and hence has something to recommend it, all else being equal. We think that further investigation of this issue to try and determine which of the remaining hypotheses is the correct one, would be of use here.

Moving on, the second notable aspect of our results is that they provide no support for the mental time travel hypotheses. Not only did we fail to find the predicted associations, but insofar as we found any association at all they tended in the opposite direction.

We did, however, find weak evidence in favour of the experiential aspect of the differential vividness hypotheses. In the past and future episodic thinking task we found a weak positive association between reporting that time robustly passes and vividly imagining the past/future. This suggests that differences in the extent to which people vividly imagine the past/future may play a small role in the variation in reports regarding whether it seems to them as though time robustly passes.

Interestingly, however, we found a stronger association between reporting that time robustly passes and vividly imagining the *present*, than between reporting that time robustly passes and vividly imagining the *past or future*. This suggests that something about differentially vividly imagining *present* events plays a more substantive role in explaining people’s differential reports regarding time’s robust passage than does differences in the vividness of past/future imaginings.

One possibility is that the more vividly people imagine present events the more salient it is that which events are being imagined as present, or being presently imagined, changes. One candidate explanation of why people report that it seems to them as though time robustly passes is that people experience a change in *which* things they perceive (Sattig 2019a; 2019b) and so people’s perceptual experiences of qualitative change are accompanied by a sense of replacement of their own experiences.

Since it seems likely that everyone experiences qualitative change, and experiences their own experiences as updating and changing, this alone does not seem likely to explain the variation in people’s reports about whether it seems to them as though time robustly passes. It could be, however, that people not only episodically imagine present events, but that they also represent there to be a change or replacement in *which* events are being episodically imagined to be present. It could then be that people who more vividly episodically imagine present events *and then represent them as being replaced by new vivid episodic imaginings*, will be more likely to report that it seems to them as though time robustly passes than will people who less vividly episodically imagine present events. We think that this idea could profitably be investigated in future research.

A second possibility is that there is a connection between differential vividness of episodic imagining of present events, on the one hand, and agentive phenomenology, on the other. As noted earlier, we know that the more that people report having a sense of agency in the present, the more likely they are to report that it seems to them as though time robustly passes (Bigg et al ms). Part of having this sense of agency involves having a phenomenology of being causally active in the present.

It could be, then, that this sense of agency is connected to a capacity to vividly episodically imagine the present, as well as, to a lesser extent, the past and future. Perhaps, for instance, feeling agentive in this manner involves episodically imagining how things are presently in order to imagine what sorts of agentive interventions will produce what sorts of results: that is, to engage in counterfactual imaginings. Part of what it is to feel agentive is to feel not only that what one does is under one’s own control, but also that one acts as one does in order to bring about certain desired outcomes. This latter aspect of agency requires having a sense of which agentive interventions will produce which outcomes, and that often involves modelling what will happen conditional on choosing certain actions: that is, it involves counterfactual imaginings. Thus, it may be that the more vivid these counterfactual imaginings, the greater the sense of agency engendered, and, in turn, the more inclined people are to report that it seems to them as though time robustly passes. We think that the connection between the vividness of episodic imagining and people’s sense of agency could profitably be investigated to see whether something like this hypothesis is correct.

Next, consider our other results. We did not find any association between participants judging that our world is dynamical, and vividly imagining the past/future. This suggests that differences in people’s beliefs about whether time is dynamical or non-dynamical are not even partially explained by differences in the vividness of their episodic imaginings. This result is consistent with previous findings in this area. We predicted that there would be an association between participants judging that our world is dynamical and vividly imagining the past/future, because we predicted there would be an association between participants reporting that it seems to them in experience as though time robustly passes, and the vividness of their episodic imaginings of the past/future, and we thought that reporting that it seems as though time robustly passes would be associated with believing that it does. Several previous studies have similarly found no association between people’s reports regarding their temporal seemings, on the one hand, and their temporal beliefs, on the other. Latham, Miller and Norton (2020) found no association between people’s beliefs about whether time is dynamical, and their reports about whether it seems as though time robustly passes, and more recently Bigg, Latham, Miller, and Yechimovitz (ms) also failed to find any such association.

Jointly, these results suggest that the reason people believe (or not) that time is dynamical is *not* based on their reports (or lack thereof) that it seems to them as though time robustly passes. If that is true, then we would not expect the variation in people’s beliefs about whether time is dynamical or not, to be sensitive to the vividness of their episodic imaginings, and this is consistent with our results. Instead, it suggests that differential vividness only plays a role in the extent to which people report that it seems to them in experience as though time robustly passes.

With this in mind, let’s consider that role in more detail. We can now distinguish two versions of the differential vividness hypothesis. According to one of these, people will be more likely to report that it seems to them as though time robustly passes in conditions in which they more vividly imagine future/past[[19]](#footnote-19) events. On this version of the hypothesis, we would expect both inter- and intra-personal variation in people’s reports regarding whether it seems to them as though time robustly passes. That is because we would expect to find both inter and intra-personal variation in the extent to which people are able to vividly imagine past/future events depending, at the very least, on the nature of the events. Call this the *specific vividness hypothesis.*

**Specific Vividness Hypothesis:** Under conditions in which people imagine past/future events vividly, they will be more inclined to report that it seems to them as though time robustly passes, and under conditions in which they imagine past/future events less vividly, they will be less inclined to report that it seems to them as though time robustly passes.

We can contrast the specific vividness hypothesis with the general vividness hypothesis. According to that hypothesis, people who have a greater capacity to imagine vividly will be more inclined to report that it seems to them as though time robustly passes, while those with a lesser capacity will be less inclined to report this.

**General Capacity hypothesis:** People with a greater general capacity to vividly imagine past/future events will be more inclined to report that it seems to them as though time robustly passes, than will those with a lesser general capacity to vividly imagine past/future events.

These hypotheses are consistent. Both could be true. But it could also be that only the general capacity hypothesis is correct. If so, we would expect to see inter-personal variation regarding the extent to which people report that it seems to them as though time robustly passes, corresponding to differences in people’s general capacity for vivid imagining, but we would not expect to see intra-personal differences that correspond to the extent to which some particular past/future event is more or less vividly imagined, since what matters to people’s reports regarding time’s robust passage is their general capacity for vivid imagining, not how well that capacity is deployed on any particular occasion.

We think that further investigation could profitably be spent in investigating these two versions of the differential vividness hypothesis.

Lastly, we want to turn to consider whether the differential vividness hypothesis, if true, gives us any reason to prefer passage realism, illusionism, or deflationism. As we noted in the introduction, while realists, illusionists and deflationism can in theory accept *all* the candidate explanations considered in this paper, some of these explanations might sit better with some views than others. However, we don’t think that accepting the differential vividness hypothesis gives us any reason to endorse one of these three views over the others.

Consider, first, passage realism. The realist can say both that (a) there can be variation in the strength of people’s veridical experience of time robustly passing and (b) there can be variation in whether people report those experiences as being as of robust passage regardless of their strength The realist can very plausibly say that differences in the capacity to vividly imagine past, present, and future episodic events results in variation in the strength of people’s veridical experience of time robustly passing. She can say that people who more vividly imagine past, present, and future episodic events will tend to have stronger experiences of time robustly passing because part of what it is to have that experience is to feel as though future events are approaching and past ones receding, and that feeling is influenced by the extent to which the past and future events are vividly imagined. She might also say that differences in vividness of episodic imagining also affect people’s reports regarding their experiences independent of their effect on the experience itself, although this seems to us to be a less obvious route to take.

Next consider the illusionist. She can say something very similar to whatever the realist says. The illusionist must think that something grounds our having an illusory experience as of robust passage. Given this, she can say that the strength of this illusory experience is influenced by the extent to which people vividly imagine past, present and future episodic events, so that people who have a greater capacity for vivid episodic imagining will have a stronger illusory experience and will therefore be more inclined to report their experiences as being one of robust passage.

The deflationist will likely take a different view of how the differential episodic vividness hypothesis explains the data. She might say that the degree to which people are able to vividly imagine past, present and future episodic events makes for a difference in the *strength* of their *veridical* experiences, such that people are more likely to misdescribe a stronger veridical experience as being one as of robust passage. She will add to that, that people are more inclined to misreport their experiences as being of as of robust passage if they more vividly imagine past, present and future episodic events.

How might that story go? The deflationist will argue that there is no sense in which we really experience future events as approaching, and past ones as receding, and no sense in which we really experience a change in which moment is objectively present. Nevertheless, we *imagine* past, present and future episodic events. Indeed, it is not only that at different times we imagine future and past episodic events as being closer or further away from us than we imagined at other times, in addition, at any particular time we can imagine some future episodic event as future, and then imagine it as present, and then as past. In doing so, we imagine a change in our relationship to that event. Imagining that change, however, can easily be *described* in terms of imagining the event approaching the present from the future, and then receding into the past. Thus, the more vivid are those episodic imaginings, the more inclined we are to describe them in ways that lead us to report that it seems to us as though time robustly passes.

Since all three of these explanations, which appeal to the differential vividness hypothesis, seem to us roughly as good as one another, we do not think that our data from this study gives us any reason to prefer one over the other (which of course is not to say that there are not other reasons to do so).

3. Conclusion

In conjunction with previous work in this area, our current findings paint a much more complicated picture of the factors that play a role in people’s reporting that it seems to them as though time robustly passes. It is not simply that everyone reports this, or that no one does: there is substantial variation in these reports. Moreover, it is not simply that there is a single factor that is responsible for this variation in reports. We now know that there are at least two separate factors that include both the extent to which people feel a sense of agency, and the extent to which they vividly episodically imagine past, present, and future events. It seems very likely that there are further factors than this, and that what people report when it comes to their temporal phenomenology is a complicated function of a range of these different factors.

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1. We use the term ‘robust’ to distinguish this kind of temporal passage from what Skow (2015) calls anodyne or anemic passage, which is the kind of temporal passage that some B-theorists endorse, and which consists in (roughly speaking) succession. See Oaklander (2015) Deng (2013) and Leininger (2021) who defend views of this kind. [↑](#footnote-ref-1)
2. A-theorists include, for instance, Bourne (2006); Broad (1923; 1938); Cameron (2015); Craig (2000); Zimmerman (2005); Skow (2015); Smith (1993); Sullivan (2012); Tallant (2012); Tooley (1997). [↑](#footnote-ref-2)
3. See, for example, Oaklander (2012), Mellor (1998); Le Poidevin (2007), Price (1996) and Farr (2012; 2020a, 2020b). [↑](#footnote-ref-3)
4. This characterisation of B-relations is intended to be neutral on whether said relations are primitive (as for instance Maudlin (2007), Oaklander (2012), Kajimoto, Miler and Norton (2020) and Tegtmeier (1996; 2014; 2016)) or are reducible to some asymmetries in the contents of time (such as for instance Mellor (1998), Le Poidevin (1991) and Albert (2000). [↑](#footnote-ref-4)
5. Where C-relations differ from B-relations in being symmetrical and hence affording time no direction. [↑](#footnote-ref-5)
6. This of course leaves open that time does not robustly pass, and so their experience as of time robustly passing is systematically illusory. [↑](#footnote-ref-6)
7. See for instance Smith (1993) and Schlesinger (1994) [↑](#footnote-ref-7)
8. See for instance Le Poidevin (2007), Paul (2010) and Dainton (2011; 2012) [↑](#footnote-ref-8)
9. See for instance Miller, Holcombe and Latham (2018), Miller (2022), Deng (2013), and Sattig (2019), Farr (2020) Frischhut (2015), Bardon (2013) and Hoerl (2014). [↑](#footnote-ref-9)
10. Hoerl (2014), Prosser (2016), Miller, Holcombe and Latham (2018). [↑](#footnote-ref-10)
11. Miller, Holcombe and Latham (2018). [↑](#footnote-ref-11)
12. Of course, there are models of robust passage on which past, present, and future events are on a par (i.e. moving spotlight views). Nevertheless, it seems reasonable to think that there will be an association between its seeming as though these events are not on an ontological par, and its seeming as though time robustly passes. [↑](#footnote-ref-12)
13. Or at least, so it seems to us. Strictly speaking this may not be true; if our world is a four-dimensional spatio-temporal manifold, then the same spatial locations do not strictly exist at different times. Nevertheless, there is a clear sense in which relatively speaking, we can occupy the same spatial location at different times. [↑](#footnote-ref-13)
14. To see the diversity of definitions regarding mental time travel, compare the below:

    “Mental time travel is a term we coined to *refer to the faculty* that allows humans to mentally project themselves backward in time to relive, or forward to prelive, events” (Suddendorf and Corballis, 2007: 299. Emphasis ours).

    “*Autonoetic consciousness is a defining property* of episodic memory. It is *expressed in experiences of mental time travel*, as in the mental rein- statement of personal experiences of previous events at which one was present.” (Gardiner, 2001: 1351. Emphasis ours).

    Trakas (2022: 148) suggests a hybrid definition, where mental time travel is defined in terms of *both* the associated phenomenology, as well as the cognitive mechanism which underlies it.

    [↑](#footnote-ref-14)
15. See De Brigard and Gessell (2016) for an overview of the evidence summarised above. [↑](#footnote-ref-15)
16. See Tulving (1985), Klein, Loftus and Kihlstrom (2002), [↑](#footnote-ref-16)
17. De Brigard and Gessell. (2016: 157). [↑](#footnote-ref-17)
18. It might be natural to think that if people judge that some intervals pass faster than others, then they *ipso facto* judge that time passes (since how else could time pass faster or more slowly if it does not pass at all?). Importantly though, judgements about the subjective speed at which time passes are judgements about how fast some interval *seems* to have taken to elapse. For instance, if you are like the current authors, it will likely seem to you as though the one hour faculty meeting took a lot longer to pass, than did the one hour coffee with friends. We take it that there can be differences in how long it feels for an interval to elapse, without it thereby being true that it seems as though time *robustly* passes, given that the latter involves its seeming as though future events are coming closer (not merely that an interval takes a certain amount of time to elapse). [↑](#footnote-ref-18)
19. And perhaps also present events given our earlier findings. [↑](#footnote-ref-19)