

An Empirical Investigation of Purported Passage Phenomenology¹

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Abstract

It has widely been assumed, by philosophers, that most people unambiguously have a phenomenology as of time passing, and that this is a datum that philosophical theories must accommodate. Moreover, it has been assumed that the greater the extent to which people have said phenomenology, the more likely they are to endorse a dynamical theory of time. This paper is the first to empirically test these assumptions. Surprisingly, our results do not support either assumption. One experiment instead found the reverse correlation: people were more likely to report having passage phenomenology if they endorsed a non-dynamical theory of time. Given that people do not have an unambiguous phenomenology as of time passing, we conclude that this is suggestive evidence in favour of veridical non-dynamism—the view that our phenomenology is veridical, and that it does not unambiguously represent that time passes. Instead, our phenomenology veridically has some quite different content.

Amongst philosophers, there is disagreement about whether or not it seems to (most of us as though time passes. That is, there is disagreement regarding whether or not we have a phenomenology *as of* time passing. Here, we use the phrase ‘as of’ to draw attention to two things. First, that the phenomenology in question has some representational content: it represents that the world is some way (namely that it is such that time passes), and second, that having a phenomenology *as of* time passing is neutral regarding whether or not said phenomenology is veridical (and hence neutral regarding whether or not the phenomenology is also *of* time passing). In what follows we will always intend the neutral characterisation of this phenomenology when we speak of a phenomenology as of time passing.

What do those who think that we have a phenomenology as of time passing take that phenomenology’s content to consist in? Here are some examples:

We are not only aware of [the passage of time] when we reflect on our memories of what has happened. We just *see* time passing in front of us, in the movement of a second hand around a clock, or the falling of sand through an hourglass, or indeed any motion or change at all.⁵

...the flow of time, or passage, as it is known, is given in experience, that it is as indubitable an aspect of our *perception* of the world *as the sights and sounds that come in upon us*, even though it is not the peculiar property of a special

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⁵ Le Poidevin, R. *The images of time: an essay on temporal representation*, (Oxford: Oxford University Press, 2007). p. 76, our emphasis.

sense.⁶

Does our impression of the flow of time, or the division of time into past, present and future, tell us nothing at all about how time is as opposed to how it merely *appears* to us muddle-headed humans?⁷

To avoid confusion, let us introduce the idea of *purported* passage phenomenology. Purported passage phenomenology is the phenomenology we in fact have, the character and veridicality of which is disputed by the theories we outline below. We will not attempt to further describe that phenomenology in neutral terms, since this will prove impossible given the disagreement about its content. We think, however, that it ought be clear enough which phenomenology it is, which is in dispute.⁸

While it is typically agreed that our purported passage phenomenology has representational content, *representationalists*⁹ hold that the phenomenal character of these experiences is exhausted by their representational content, while *anti-representationalists* hold that the phenomenal character of these experiences is not exhausted by their representational content. Aside from the representationalist/anti-representationalist divide, there are three main axes of disagreement amongst philosophers interested in our purported passage phenomenology, as illustrated by figure 1 below.

The first is between those who think that our purported passage phenomenology is indeed a phenomenology as of passage and those who deny that it has this content. Amongst those who deny that our purported passage phenomenology is as of temporal passage, there is disagreement about what content it has, and thus we will simply call this *non-passage* phenomenology.

The second is the more familiar disagreement between temporal dynamists and non-dynamists. *Dynamists* think that there is in fact temporal passage, while *non-dynamists* deny this. The third is between *veridicalists* and *illusionists*. Veridicalists think that the content of our purported passage phenomenology is veridical: it represents that the world is some way, and the world in fact is that way. By contrast, illusionists think that the content of our purported passage phenomenology is illusory: it represents something that does not obtain.

⁶ Schuster, M. M. (1986). "Is the Flow of Time Subjective?", *The Review of Metaphysics*, xxxix: 695–714. p. 695, our emphasis.

⁷ Davies, P. *About Time: Einstein's Unfinished Revolution* (Harmondsworth: Penguin, 1995). p. 275, our emphasis.

⁸ One might worry that this is not so, and that there might be no particular phenomenology, the content of which is in dispute. Insofar as this is a concern, it is (i) not one we can fully address here, and (ii) quite generally a problem for discussions about temporal phenomenology and the metaphysics of time. We think, however, that given that many aspects of the descriptions of purported passage phenomenology are neutral between its representing that time passes or not (for example, those that appeal to phenomenology of motion, change, continuity, and so on) it is reasonable to think that we all have some idea which phenomenology it is, which is under dispute.

⁹ Also sometimes known as intentionalists.

		Content of Purported Passage Phenomenology	
		As of Passage	As of Non-passage
Dynamical World	Veridical Passage Phenomenology <i>Veridical Dynamists</i>	Illusory Non-passage Phenomenology <i>Unoccupied</i>	
Non-dynamical World	Illusory Passage Phenomenology <i>Illusory Passage Theorists</i>	Veridical Non-passage Phenomenology <i>Veridical Non-dynamists</i>	

Figure 1. The interaction between whether our world is dynamical or not, and the content of our purported passage phenomenology.

Veridical dynamists think that our purported passage phenomenology represents that time passes, and is veridical since time in fact passes. Illusory passage theorists agree that our purported passage phenomenology represents that time passes, but since they think that time does not pass, they think that this phenomenology is illusory. Veridical non-dynamists think that time does not pass, and we do not represent that time passes. Hence we have veridical non-passage phenomenology. Since we know of no one who thinks that our purported passage phenomenology is not as of passage, but that time does in fact pass, we will not consider such a view hereafter.

While there is conceptual space for a non-representationalist version of veridical dynamism, we think veridical dynamists are typically representationalists, and that is the version of the view we will consider here.¹⁰ Likewise, as there is little reason for illusionists to suppose that there is some phenomenal character that is not exhausted by the content of the illusion, the version of illusory passage theory we have in mind is a view that endorses representationalism.¹¹

¹⁰ Indeed, it is common for veridical dynamists to argue that the content of our phenomenology gives us reason to believe that time passes. See Smith, Q. (1994). "The Phenomenology of a-Time." in L. Nathan Oaklander and Quentin Smith (eds.) *The New Theory of Time*. (New Haven London: Yale University Press). pp. 351–59., Craig, W. L. *The Tensed Theory of Time: A Critical Examination* (Dordrecht: Kluwer Academic, 2000), and Schlesinger, G. N. *Timely Topics*. (New York: St Martin's Press, 1994).

¹¹ This view is sometimes known as phenomenal illusionism. For this terminology see Miller, K., Holcombe, A., & Latham, A. J. (2018). Temporal phenomenology: phenomenological illusion versus cognitive error. *Synthese*, DOI: 10.1007/s11229-018-1730-y and Baron, S., Cusbert, J., Farr, M., Kon, M., & Miller, K (2015). "Temporal Experience, Temporal Passage and the Cognitive Sciences." *Philosophy Compass*. x (8): 56–571. For defence and discussion of the view see Paul, L. A. (2010). "Temporal Experience." *Journal of Philosophy* CVII (7): 333–359, Prosser, S. (2007). "Could we experience the passage of time?" *Ratio*, xx: 75–90, Prosser, S. (2012). "Why does time seem to pass?" *Philosophy and Phenomenological Research*, LXXXV: 92–116, Prosser, S. (2013). "Passage and perception." *Noûs*, XLVII: 69–84., Callender, C. (2008). "The common now." *Philosophical Issues* XVIII (1):339-361.; Le Poidevin, R. *The images of time: an essay on temporal representation*, *op. cit.*, Dainton, B. "Time, Passage and Immediate Experience." in Craig Callender (ed.), *Oxford Handbook of Philosophy of Time*. (Oxford: Oxford University Press, 2011), p. 405., Ismael, J. Decision and the Open Future. In A Bardou (ed.) *The Future of the Philosophy of Time*. (New York: Routledge, 2012) pp. 149-169., and Hohwy, J., Paton, B., Palmer, C. (2015). "Distrusting the Present." *Phenomenology*

By contrast, there are both representationalist and anti-representationalist versions of *veridical non-dynamism*. These views provide different explanations of why people *misreport* the content of their phenomenology (which is, veridically, *not* of passage). Anti-representationalist veridical non-dynamists suggest that this misreporting is due to our experiences having a phenomenal character (one could think of it as a ‘flowy’ character) that outstrips their content.¹² Representationalist veridical non-dynamists suggest, instead, that some kind of cognitive error leads to mistaken beliefs about the content of our phenomenology.¹³

Importantly, all parties presuppose that people at the very least *report* having a phenomenology as of time passing, and that this is a datum that philosophical theories must accommodate.¹⁴ Veridical dynamism, veridical non-dynamism, and illusory passage theory reflect three ways of doing so, and they are evaluated (in part) by how well they are taken to succeed. To date, however, there is no evidence that people report having a phenomenology as of time passing, beyond first-person reports by philosophers and physicists. This paper seeks to find such evidence. For it may be that there is no such datum that requires accommodation, or that the datum is somewhat different than it has been supposed to be.

In §I we outline the extant literature on these issues, which informs both our hypotheses and the design of our two experiments. §II describes our methodology and surprising results, while §III discusses the ramification of these results for contemporary philosophical debate in this area.

I. The Literature

Though to date there has been no research into whether or not people report having a phenomenology as of time passing, social scientists have noted that many languages

and the Cognitive Sciences, xv (3): 315-335. DOI: 10.1007/s11097-015-9439-6. There are non-standard versions of illusionism such as that defended by Prosser, who holds that there is no content as of time passing but nor is the relevant content veridical. Instead, our purported passage phenomenology includes an incoherent representation of a moving enduring self, and this gives rise to people mistakenly thinking that it seems to them as though time passes Prosser, S. *Experiencing Time*. (Oxford: Oxford University Press, 2016). This is not a version of illusory non-dynamism, though it is a version of illusionism.

¹² See Torrenco, G. (2017). “Feeling the passing of time.” *The Journal of Philosophy*, CXIV (4): 165-188.

¹³ Perhaps a relatively low-level mechanism (such as sub-personal inference) leads us astray, or perhaps the relevant phenomenology is cognitively penetrated or conceptually mediated (through a dynamical representation or concept of time, for instance, or through linguistic or other conceptual features). See Hoerl, C. (2014), “Do we (seem to) perceive passage?” *Philosophical Explorations*, xvii: 188–202., Torrenco, G. (2017). “Feeling the passing of time.” *op.cit.* Braddon-Mitchell, D. (2013). “Against the illusion theory of temporal phenomenology.” *CAPE Studies in Applied Ethics*, ii: 211–233., Deng, N. (2013a). “On Explaining Why Time Seems to Pass”. *Southern Journal of Philosophy* LI(3): 367-382., Deng, N. (2013b). “Our Experience of Passage on the B-theory”, *Erkenntnis* LXXVIII(4): 713-726.; Bardon, A. *A Brief History of the Philosophy of Time*. (Oxford: Oxford University Press, 2013), p. 95., Baron, S., Cusbert, J., Farr, M., Kon, M., & Miller, K. “Temporal Experience, Temporal Passage and the Cognitive Sciences.” *op. cit.* and Miller, K., Holcombe, A., & Latham, A. J. “Temporal phenomenology: phenomenological illusion versus cognitive error” *op. cit.*

¹⁴ Though see Miller, K. (2019). “Does it Really Seem as Though Time Passes?” in In Adrian Bardon, V. Artsila, Sean Enda Power & A. Vatakis (eds.), *The Illusions of Time: Philosophical and Psychological Essays on Timing and Time Perception*, Palgrave MacMillan, who raises the possibility that it doesn’t seem to people as though time passes, and that it is an open question whether they even report its seeming that way.

include one or both of what are known as *moving time* or *moving ego* metaphors.¹⁵ The moving time metaphors are a suite of expressions which suggest that time itself moves, while the moving ego metaphors are a suite of expressions which suggest that the ego moves through time. In both cases, the relevant expressions employ motion verbs such as ‘his birthday is *approaching*’ (moving time metaphor) or ‘he is *nearing* his birthday’ (moving ego metaphor).

If people either have phenomenology whose content is as of time passing, or have non-passage phenomenology and misdescribe that phenomenology as being as of time passing—that is, if they *report* that they have phenomenology as of passage—it seems reasonable to think that they will agree that things *seem* to be as described by a range of moving time expressions. That is, someone’s agreement that that things seem to be as described by a range of moving time expressions partially constitutes them reporting having a phenomenology as of passage. Conversely, if people do not agree that things seem to be as described by a range of moving time expressions, this is partially constitutive of the fact that they do not report having a phenomenology as of passage.

Our studies test people’s levels of agreement (on a Likert scale) both to things seeming as they are described by a suite of moving time expressions, *and* to things seeming as they are described by a suite of moving ego expressions. For short, we will henceforth talk of people’s *agreement to moving time expressions* and *agreement to moving ego expressions*, where these are shorthand for people agreeing that things seem as they are described by those expressions.

Given that in our studies we ask participants how strongly they agree (or disagree) with a range of moving time and moving ego expressions, we are interested in three questions. First, we want to know whether there is a *correlation* between levels of agreement to moving time expressions and moving ego expressions. Second, we want to know how *strongly* people agree with moving time expressions. Call this *strength of agreement*. Third, we want to know how *variable* people’s responses are to moving time expressions. It could be that some people strongly agree to moving time expressions, while others strongly disagree to moving time expressions. In that case, we have high variability in responses. Alternatively, it could be that people’s responses are fairly tightly clustered around some particular response. Call this *variability of agreement*. What ought we predict regarding correlations between the two kinds of expression, and strength and variability of agreement to moving time expressions?

It is unclear how moving ego expressions are connected with moving time expressions. It might be that these two kinds of expressions are two ways of reporting the *same* phenomenology, or that they report two *distinct* phenomenologies. If the former is the case, then either people are equally likely to use either form of expression to describe their phenomenology, in which case there will be a correlation between levels of agreement to the two suites of expressions, or some people are more likely to use one suite of expressions than the other, in which case we should at best, see a weak correlation. If the latter is the case, then there are two phenomenologies described by two suites of expressions. Then either some, or all, people have both phenomenologies, in which case there will be a correlation between levels of agreement to the two suites of

¹⁵ See Sinha, C., & Gardenfors, P. (2014). “Time, space, and events in language and cognition: A comparative view.” *Annals of the New York Academy of Sciences. Issue: Flow of Time*, XL:1–10.

expressions, or some people have one phenomenology and some the other, in which case we should see no such correlation.

The simpler hypothesis is that there is a single phenomenology, and that people will use both suites of expressions to describe that phenomenology. Thus our first hypothesis is that there will be a correlation between levels of agreement to moving time expressions and moving ego expressions.

Both veridical dynamists and illusory passage theorists ought predict that people will agree, with high strength, to moving time expressions. Moreover, they ought predict that there will be little variability. Veridical dynamists, after all, think that this phenomenology is all-pervasive,¹⁶ and that the sorts of perceptual or quasi-perceptual mechanisms that are likely to be involved in tracking temporal passage (either directly, or via tracking change and motion) are relatively low-level mechanisms which can be expected to be present in almost all human beings.¹⁷ Similarly, illusory passage theorists typically appeal to low-level, widely shared mechanisms to explain why it is that we are subject to this illusion.¹⁸

We think veridical non-dynamists will make different predictions depending on whether or not they are representationalists. Anti-representationalists like Torrenço¹⁹ think that the ‘flowy’ character of our phenomenology is primitive, and pervades all our experiences. This suggests that there will be relatively little variability between individuals regarding their having experiences with this phenomenal character. Hence anti-representationalist veridical non-dynamists of this stripe ought predict that people will, with high strength and little variability, agree to moving time expressions.

Representationalist veridical non-dynamists think we have veridical phenomenology, which, while not as of passage, is sufficiently ambiguous that veridical dynamists and illusory passage theorists mistakenly think it represents time passing.²⁰ One possibility is that because of this ambiguity, how people describe that phenomenology will be highly sensitive to contextual factors. For instance, it might largely be a product of how they interpret their phenomenology, which, in turn, will be determined by relatively inter-personally variable higher-level mechanisms (such as, for instance, their theory of time,

¹⁶ For discussion see Prosser, S. “Could we experience the passage of time?” *op. cit.*, Prosser, S. “Passage and perception.” *op. cit.*, and Miller, K. “The Cresting Wave: A New Moving Spotlight Theory” *op. cit.*

¹⁷ For instance, the human middle temporal visual area (MT) plays an important role in, amongst other things, discriminating motion and its direction (see Zeki, S., Watson, J. D., Lueck, C. J., Friston, K. J., Kennard, C., & Frackowiak, R. S. (1991). “A direct demonstration of functional specialization in human visual cortex.” *Journal of Neuroscience*, XI (3): 641-649., and Neri, P., Morrone, M. C., & Burr, D. C. (1998). “Seeing biological motion.” *Nature*. CCCXCV (6705): 894-896. For review, see Born, R. T., & Bradley, D. C. (2005). “Structure and Function of Visual Area MT.” *Annual Review of Neuroscience*. XXVIII: 157-189. Visual area MT seems to be conserved across all known primates and is present in all neurotypical human beings (for review, see Tootell, R. B.H., Tsao, D., & Vanduffel, W. (2003). “Neuroimaging Weighs In: Humans Meet Macaques in “Primate” Visual Cortex.” *Journal of Neuroscience*, XXIII (10): 3981-3989.).

¹⁸ Illusory passage theorists have proposed that our phenomenology is the product of our motion phenomenology (Le Poidevin, R. *The images of time: an essay on temporal representation*, *op. cit.* p. 76; Paul, L. A. “Temporal Experience.” *op. cit.*), the product of our motion phenomenology in combination with our phenomenology of change (*ibid*, p. 346), the product of our temporal updating mechanisms (Hoerl, C. and McCormack, T. (2019). “Thinking in and about time: A dual systems perspective on temporal cognition.” *Behavioural and Brain Sciences*, XVII, doi:10.1017/S0140525X18002157) or the result of perceptual updating via a Bayesian inference theory of perception (Hohwy, J., Paton, B., Palmer, C. “Distrusting the Present.” *op. cit.*).

¹⁹ Torrenço, G. “Feeling the passing of time.” *op. cit.*

²⁰ See Miller, K., Holcombe, A., & Latham, A. J. “Temporal phenomenology: phenomenological illusion versus cognitive error.” *op. cit.* for discussion of ambiguity of this content.

which we discuss in more detail below) so that some people will strongly agree that it seems as though time moves, and others will strongly disagree that this is how it seems. In this case there will be high degrees of variability of reports, and high strength of reports.

Alternatively, it might be that because the content of the phenomenology is ambiguous between representing passage and representing non-passage, people will neither strongly agree, nor disagree, that it seems as though time moves. Hence there will be little variation in reports, (since reporting is not influenced by contextual factors) but the strength of agreement to moving time expressions will be low. Hence representationalist veridical non-dynamists ought make a disjunctive prediction: that there will be high variability and high strength of reports, or there will be low variability and low strength of reports.

On the basis that most of the theories make this prediction, our second hypothesis is that, with low variability, people will report strongly agreeing to moving time expressions.

In addition to testing participants' levels of agreement to moving time and moving ego expressions, we also aimed to test whether there are correlations between levels of agreement to these expressions and endorsing a dynamical or non-dynamical theory of time. Here, we distinguish between endorsing a dynamical theory of time, on the one hand, and believing that 'time passes' is true, on the other hand. Call this latter a naïve belief that time passes. What is notable about that belief is that it might easily be consistent with either a dynamical or a non-dynamical theory of time being true. For we take it that even non-dynamists will allow that there is *some* sense in which time passes, namely the sense in which the time, now, is different from what time it was 5 minutes ago.

By contrast, someone's theory of time, which we take to be a tacit representation of the temporal nature of the world, can either be closer to a dynamical model (of some kind) or to a non-dynamical model. There is already empirical evidence that people have such a tacit theory, and that it robustly tracks the difference between dynamical and non-dynamical models of time.²¹ In what follows we assume that certain aspects of this tacit theory can be accessed by presenting people with descriptions of different metaphysical models and asking which description most resembles our world. We take people's responses to such questions to be defeasible evidence of which theory of time they (tacitly) endorse. Henceforth when we talk of which theory of time people endorse, this is what we intend. We call those people who choose a dynamical model as most resembling our world, dynamists, and those who choose a non-dynamical model as most resembling our world, non-dynamists.

Our study does not speak to the issue of whether there is some widely shared naïve belief that time passes, nor whether, if there is, the content of that belief is theory-neutral with regard to dynamical and non-dynamical theories of time. Our results shed no light on whether, for instance, when dynamists assert that 'time passes' the content of what they assert is different from the content of what non-dynamists assert. Nor do our results speak to the issue of whether, if there is a widely shared naïve belief that time passes, that

²¹ See Latham, A. J., Miller, K. & Norton, J. (2019). "Is our naïve theory of time dynamical?" *Synthese*. DOI: 10.1007/s11229-019-02340-4.

belief is connected in any interesting way with people's reported phenomenology. Both of these issues would be of interest to pursue in the future.

Importantly, although the moving time expressions with which we present our participants are everyday expressions, in comparison to the expression 'time passes' it is much less plausible to read these as being theory-neutral expressions of the way things *seem*. These expressions include expressions such as 'it feels like the future is ahead of me, and is moving towards me' and 'it feels like time is whizzing towards me'. We think that if people report having a phenomenology whose content is as of passage—whether it really is as of passage, or whether this a mistaken report of phenomenology with some other content—they ought agree with moving time expressions, while if they do not report this phenomenology, they ought not.

With that important clarification made, what predictions ought we make regarding the correlation between people's tacit theory of time, and their reports of their purported passage phenomenology? Since veridical dynamists and illusory passage theorists think our phenomenological states represent that time passes, and that this phenomenology informs people's tacit theory of time, these theorists ought predict that the greater the extent to which participants agree with moving time expressions, the more likely they are to endorse a dynamical rather than non-dynamical theory of time. Anti-representationalist veridical non-dynamists ought also make this prediction, insofar as they think that the representational character we mistake for content will inform our picture of the world.

Interestingly, we expect many representationalist veridical non-dynamists to make the same prediction. That's because recent defences of representationalist veridical non-dynamism hypothesise that people misreport their non-passage phenomenology as phenomenology as of passage (assuming they do) because they deploy a dynamical theory of time, and this either results in the phenomenology being cognitively penetrated by this theory, or leads them to misdescribe their phenomenology. If something like these hypotheses are right, then the greater the extent to which someone reports having a phenomenology as of time passing, the more likely they are to endorse a dynamical theory of time. Representationalist veridical non-dynamists who attempt to explain these reports by appealing to something other than a tacit dynamical theory of time need not predict this correlation. It is, however, generally plausible that if people report having a phenomenology as of time passing, that whatever underpins this report might inform their tacit theory of time (even if that theory does not explain why they make that report). If so, then such veridical non-dynamists might still predict this correlation. Thus our third hypothesis is that there will be a correlation between levels of agreement to moving time expressions and endorsing a dynamical theory of time.

In addition, some non-dynamists have suggested that our phenomenology is *really* a veridical phenomenology as of a moving ego, which results from there being series of egos, at different temporal locations, with nested memories of egos at past locations (Ismael, 2012) and that dynamists misdescribe this phenomenology as a phenomenology as of time moving.²² These non-dynamists hypothesise that there is a single phenomenology that dynamists are more likely to describe using moving time expressions, and non-dynamists are more likely to describe using moving ego

²² Though whether that phenomenology is veridical will depend on how the idea of a moving ego is understood. After all, in some good sense nothing moves, including egos, in a non-dynamical world.

expressions. In line with this, our fourth hypothesis is that there will be a correlation between levels of agreement to moving ego expressions and endorsing a non-dynamical theory of time.

In sum, we have four hypotheses:

- (i) Levels of agreement to moving time expressions will correlate with levels of agreement for moving ego expressions.
- (ii) With low variability, people will report strongly agreeing to moving time expressions.
- (iii) Higher levels of agreement with moving time expressions will correlate with endorsing a dynamical rather than non-dynamical theory of time.
- (iv) Higher levels of agreement with moving ego expressions, will correlate with endorsing a non-dynamical rather dynamical theory of time.

II. Experimental Design and Results

II.1 Experiment 1 Method

II.1.1 Participants. 333 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated \$1 for approximately 15 minutes of their time. 12 participants were excluded for failing to follow task instructions. This means that they failed to answer the questions, or failed an attentional check question. The remaining sample was composed of 321 participants (aged 21-69; 127 female). Mean age 34.83 (SD = 10.97). 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.

II.1.2 Materials and Procedure. All participants read a series of statements about their temporal phenomenology and were asked how much they agreed, on a Likert scale of 1 (strongly disagree) to 7 (strongly agree) with each statement. Since there is no prior empirical work in this area, and hence no agreed-on measure, we presented participants with moving time expressions such as ‘I can feel time passing’, and moving ego expressions such as ‘It feels like the past is behind me, and I am moving away from it’. In order to control for question effects—effects due to being asked to agree that, for instance, one *is not* moving through time, as opposed to being asked to agree that one *is* moving through time—we presented each statement to each participant in both a positive and negative form. In order to amalgamate these results, levels of agreement to moving time and moving ego statements in negative form were reverse-coded (that is, a response of 1 was transformed into a response of 7; a response of 2 was transformed into a response of 6, and so on). The upshot of this is that when we report *higher levels of agreement to any* statement, we report higher levels of agreement that it seems as though time moves, or the ego moves. Statements were presented in random order, and are listed in full in §II.3.

Participants then read two vignettes: one representing a dynamical theory (a presentist world) and the other, a non-dynamical theory (an eternalist world). The order of presentation of the vignettes was randomised.

The dynamical vignette read as follows:

Imagine a universe (Universe C) in which the only events and objects that exist, are those in the present moment. So in Universe C, past events and objects, and future events and objects, do not exist. Universe C is a giant three dimensional object that is extended in space, but not extended in time. It is comprised of only present objects. In Universe C, which objects exist, and what properties those objects have, *changes*. So Universe C is constantly changing, so that objects that did exist, in the past, go out of existence as present objects come into existence. But past objects no longer exist, and 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 earlier, 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).

The non-dynamical vignette read as follows:

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 relations of earlier-than and later-than 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 of earlier-than and later-than. 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 earlier-than 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 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).

While we attempted to make the vignettes as accessible as possible, to allow us to exclude participants who did not understand the vignette as intended we included the following statements after each vignette, and asked participants whether they were true or false.

1. In Universe [C/B] the present is real, the past and future are not.
2. In Universe [C/B] which events are present, changes.
3. In Universe [C/B] the past, present, and future, are real.

Finally, both vignettes were once again presented, and participants were asked “Which of these universes do you think is most like our own?”. They were then asked to indicate their level of confidence in their previous judgment.

Participants who failed to correctly answer at least two of the comprehension questions, about the vignette they thought best described our universe, were excluded from analyses that took into account which model of time people thought most like our universe. At no point could participants return to a previous screen.

II.2 Experiment 2 Method

II.2.1 Participants. 338 people participated in the study. Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk, and compensated \$0.50 for approximately 5 minutes of their time. 11 participants were excluded for failing to follow task instructions. This means that they failed to answer the questions, or failed an attentional check question. The remaining sample was composed of 327 participants (aged 21-99; 118 female; 1 prefer not to answer). Mean age 33.47 (SD = 10.00). 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.

II.2.2 Materials and Procedure. The methodology for experiment 2 was exactly the same as for experiment 1, except that the dynamical vignette represented a growing block world, instead of a presentist world.

The dynamical vignette read as follows:

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 the set of events and objects that have just come into existence are those that are in the present. As new events and objects come into existence, already existing events and objects become part of the past. 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 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).

II.3 Analyses

II.3.1 Experiment 1 Main Results. Before reporting the statistics and details, let us begin by seeing how our four hypotheses fared.

First, we found a strong positive correlation between levels of agreement to positive moving time and positive moving ego expressions, and to negative moving time expressions and negative moving ego expressions.

Second, we did not find the predicted strong agreement, with low variability, to moving time expressions. The overall level of agreement to moving time expressions appears to be between 4 and 5. So, at best, people weakly agree with moving time expressions. However, this result appears to be driven by two-distinct sub-populations: (1) a majority group who agree with moving time expressions (70% when the expression is positive and 55% when the expression is negative) and (2) a substantial minority group who disagree with moving time expressions (25% when the expression is positive and 40% when the expression is negative).

Third, we did not find the predicted correlation between agreement to moving time expressions and endorsing a dynamical rather than non-dynamical theory of time. Surprisingly, we found the opposite correlation: participants who endorsed a non-dynamical theory overall report slightly (but significantly) higher levels of agreement to moving time expressions than those who endorse a dynamic theory.

Fourth, we found the predicted correlation between agreement to moving ego expressions and endorsing a non-dynamical rather than dynamical theory of time. Participants who endorsed a non-dynamical theory report slightly (but significantly) higher levels of agreement to moving ego expressions than those who endorsed a dynamic theory.

Table 1 reports levels of agreement to moving time and moving ego expressions in positive form. 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. The p -values and t -values jointly tell us whether the mean is statistically significantly different from 4 (from indifference). A p -value of < 0.05 tells us that the mean is statistically significant from 4. In Table 1, the mean is significantly above 4 for all expressions.

Table 1. Levels of agreement to positive expressions.²³

	%Yes	%No	%4	Mean	SD	t-value	p-value
Moving Time Expressions	71.4	24.6	4	4.74	1.20	10.948	<.001
1) It feels like the future is ahead of me, and it is moving towards me.	67	22.7	10.3	4.85	1.65	9.178	<.001
2) It feels like the past is behind me, and it is moving away from me.	73.5	19.3	7.2	5.02	1.63	11.212	<.001
3) It feels like time is a moving river that I am floating upon.	62.3	26.2	11.5	4.61	1.72	6.328	<.001
4) It feels like time is whizzing towards me.	56.4	32.1	11.5	4.39	1.81	3.821	<.001
5) I can feel time passing.	72	19.6	8.4	4.99	1.60	11.067	<.001
6) It feels to me like the present moves.	62.3	27.1	10.6	4.57	1.68	6.034	<.001
Moving Ego Expressions	82.3	14	3.7	5.20	1.23	17.464	<.001
1) It feels like I am moving through time, away from the past and towards the future.	75.4	16.5	8.1	5.24	1.51	14.691	<.001
2) It feels like the future is ahead of me and I am moving towards it.	79.2	12.1	8.7	5.38	1.41	17.516	<.001
3) It feels like the past is behind me, and I am moving away from it.	76	14.3	9.7	5.28	1.45	15.831	<.001
4) It feels like time is a road, and I am in a moving vehicle travelling along that road.	67.3	22.1	10.6	4.89	1.64	9.726	<.001

Table 1 shows us the percentages of people who agreed, disagreed, or neither, to each of these statements. However, since we counted weak agreement (5) and weak disagreement (3) as agreement, and disagreement, respectively, Table 1 does not tell us the percentage of people who strongly agreed (6-7) or strongly disagreed (1-2) with these statements, nor the percentage of people who neither strongly agreed nor strongly disagreed (3-5). Table 1a re-presents the same data, but divides people in this manner. The first column is those who strongly agree, the second those who strongly disagree, and the third column those who neither strongly agree nor disagree.

²³ Notice that the bold values in the table are not averages of the below results. Instead they reflect the results we get when we calculate, for each participant, their average level of agreement for this type of question. For instance, the top row indicates that only 4% of participants had an average response of '4' to moving time expressions, while the below results in that column show that, for each question, between 7.2% and 11.5% of participants responded with 4. Likewise for tables 1a, 2, 2a, 4, 4a, 5 and 5a. For tables 1, 2, 4, and 5, participants with an average response <4 were classified as '%No', while participants with an average response >4 were classified as '%Yes'. Participants with an average response =4 were classified as '%4'.

Table 1a Levels of agreement to positive expressions reported as strong agreement/disagreement and neither strong agreement nor strong disagreement.²⁴

	%SA	%SD	%N
Moving Time Expressions	48	2.5	49.5
1) It feels like the future is ahead of me, and it is moving towards me.	39.6	10.6	49.8
2) It feels like the past is behind me, and it is moving away from me.	44.6	10.3	45.2
3) It feels like time is a moving river that I am floating upon.	33.3	15.6	51.1
4) It feels like time is whizzing towards me.	31.1	21.2	47.6
5) I can feel time passing.	43.3	9.3	47.4
6) It feels to me like the present moves.	31.1	14.3	54.6
Moving Ego Expressions	64.2	1.6	34.2
1) It feels like I am moving through time, away from the past and towards the future.	50.4	6.5	43
2) It feels like the future is ahead of me and I am moving towards it.	53.9	4.4	41.7
3) It feels like the past is behind me, and I am moving away from it.	50.4	5	44.5
4) It feels like time is a road, and I am in a moving vehicle travelling along that road.	40.1	10.9	48.9

Table 2 reports levels of agreement to moving time and moving ego expressions in negative form. Recall that responses to these statements were reverse-coded.

Table 2. Levels of agreement to negative expressions.

	%Yes	%No	%4	Mean	SD	t-value	p-value
Moving Time Expressions	56.7	39.3	4	4.34	1.53	3.974	<.001
1) It does not feel like the future is ahead of me, and it is moving towards me.	51.7	39.9	8.4	4.37	1.94	3.460	.001
2) It does not feel like the past is behind me, and it is moving away from me.	54.8	34.6	10.6	4.60	1.90	5.635	<.001
3) It does not feel like time is a moving river that I am floating upon.	47	42.4	10.6	4.16	1.91	1.463	.144
4) It does not feel like time is whizzing towards me.	42.1	48.6	9.3	3.97	2.00	-0.307	.759
5) I cannot feel time passing.	48	43.6	8.4	4.63	1.99	5.691	<.001
6) It does not feel to me like the present moves.	48.9	39.9	11.2	4.31	1.92	2.875	.004
Moving Ego Expressions	61.7	33.6	4.7	4.64	1.65	6.913	<.001
1) It does not feel as though I am moving through time, away from the past and towards the future.	58.9	32.1	9	4.74	1.88	7.021	<.001
2) It does not feel like the future is ahead of me and I am moving towards it.	59.5	33.3	7.2	4.74	1.91	6.918	<.001
3) It does not feel like the past is behind me, and I am moving away from it.	56.7	36.1	7.2	4.63	1.98	5.698	<.001
4) It does not feel like time is a road, and I am in a moving vehicle travelling along that road.	54.2	38.6	7.2	4.43	1.90	4.120	<.001

²⁴ For tables 1a, 2a, 4a, and 5a, participants with an average response ≤ 2 were classified as '%SD', while participants with an average response ≥ 6 were classified as '%SA'. Participants with an average response between 2.X and 5.X were classified as '%N'. Participants with an average response =4 were classified as '%4'.

In this case we see that the mean is significantly above 4 (indifference) for all expressions except Moving Time expressions (3) and (4).

Table 2a presents the same data, but divided into participants who strongly agree, strongly disagree, and neither strongly agree nor disagree.

Table 2a. Levels of agreement to negative expressions reported as strong agreement/disagreement and neither strong agreement nor disagreement.

	%SA	%SD	%N
Moving Time Expressions	33.3	6.2	60.5
1) It does not feel like the future is ahead of me, and it is moving towards me.	35.2	19.3	45.5
2) It does not feel like the past is behind me, and it is moving away from me.	41.4	17.8	40.8
3) It does not feel like time is a moving river that I am floating upon.	30.5	22.4	47.1
4) It does not feel like time is whizzing towards me.	29.9	29	41.1
5) I cannot feel time passing.	42.7	18.4	38.9
6) It does not feel to me like the present moves.	35.2	21.2	43.6
Moving Ego Expressions	45.5	5.6	48.9
1) It does not feel as though I am moving through time, away from the past and towards the future.	46.4	16.8	36.8
2) It does not feel like the future is ahead of me and I am moving towards it.	45.2	16.8	38
3) It does not feel like the past is behind me, and I am moving away from it.	45.5	19.6	34.9
4) It does not feel like time is a road, and I am in a moving vehicle travelling along that road.	37.4	19.6	43

To determine the correlation between people's levels of agreement to moving time and moving ego expressions Pearson's correlation coefficients were calculated between levels of agreement for all 4 kinds of expression. The results are summarised in Table 3 below.

Table 3. Correlation matrix for levels of agreement for positive and negative expressions.

		Positive		Negative	
		Moving Time	Moving Ego	Moving Time	Moving Ego
Positive	Moving Time	-	.68**	.17*	.04
	Moving Ego		-	.29**	.31**
Negative	Moving Time			-	.87**
	Moving Ego				-

N.B. * $p < .05$ ** $p < .001$

In addition to the correlations noted at the beginning of this section, there was also a weak correlation between people's levels of agreement to positive moving time expressions and negative moving time expressions, and between positive moving ego expressions and negative moving ego expressions, and between positive moving ego expressions and negative moving time expressions.

Of the original 321 participants, 213 participants correctly answered at least 2 of the 3 comprehension questions, and the following results include only these participants.

However, the results are robust: rerunning the analyses with *all* participant responses does not alter the main results.

118 participants judged that the non-dynamical universe was most like our universe. We will call these participants non-dynamists. 95 participants judged that the dynamical universe was most like our universe. We will call these participants dynamists. There was no significant difference in confidence between non-dynamists ($M = 5.33$, $SD = 1.50$) dynamists ($M = 5.09$, $SD = 1.407$; $t(211) = 1.171$, $p = .243$).

Level of agreement was analysed using a repeated-measures ANOVA. The ANOVA included within-subjects factors of kind of passage expression (moving time; moving ego) and expression form (positive; negative) and a between-subjects factor of theory of time (non-dynamism; dynamism).

The 2x2x2 repeated-measures ANOVA revealed a main effect of passage expression $F(1, 211) = 44.322$, $p < .001$, $\eta_p^2 = .252$, expression form $F(1, 211) = 7.918$, $p = .005$, $\eta_p^2 = .036$, and a main effect of theory of time $F(1, 211) = 5.606$, $p = .019$, $\eta_p^2 = .026$. There was also a significant interaction between expression form and passage expression $F(1, 211) = 8.974$, $p = .041$, $\eta_p^2 = .041$.²⁵

The main effect of passage expression showed that there were higher levels of agreement for moving ego expressions ($M = 5.00$, $SD = 1.71$) than for moving time expressions ($M = 4.54$, $SD = 1.53$).

The main effect of expression form revealed that overall levels of agreement were significantly higher for positive expressions ($M = 4.92$, $SD = 1.63$) than for negative expressions ($M = 4.61$, $SD = 2.15$).

The main effect of theory of time showed that non-dynamists ($M = 4.94$, $SD = 1.06$) showed higher levels of agreement to all passage expressions (moving time and ego) than dynamists ($M = 4.59$, $SD = 1.06$).

Simple effects tests using a Bonferroni correction were carried out on the two-way interaction between expression form and passage expression. For positive expressions, levels of agreement to moving ego ($M = 5.20$, $SD = 1.28$) were significantly higher than to moving time ($M = 4.65$, $SD = 1.23$; $p < .001$). For negative expressions, levels of agreement to moving ego ($M = 4.79$, $SD = 1.65$) were significantly higher than to moving time ($M = 4.43$, $SD = 1.62$; $p < .001$).

For moving time expressions, there was no significant difference between levels of agreement to positive and negative expression forms ($p = .069$). For moving ego expressions, levels of agreement for positive expressions were significantly higher than for negative expressions ($p < .001$).

II.3.2 Experiment 2 Main Results. The results of this experiment replicated those of experiment 1 for our first and second hypotheses, but not for our third and fourth hypotheses.

²⁵ Partial eta squared (η_p^2) is a measure of effect size. While effects are often reported as being statistically significant or statistically non-significant, statistically significant effects can vary in their size. Roughly, an effect size value of 0.01 indicates a small effect, and effect size value of 0.06 indicates a medium effect, and an effect size value of 0.14 indicates a large effect.

First, we once again found a strong positive correlation between levels of agreement to positive moving time and positive moving ego expressions, and to negative moving time expressions and negative moving ego expressions.

Second, we did not find the predicted strong agreement, with low variability, to moving time expressions. The overall level of agreement to moving time expressions was again between 4 and 5. This result appears again to be driven by two-distinct sub-populations: (1) a majority group who agree with the moving time expressions (80% when the expression is positive and 50% when the expression is negative), and (2) a minority group who disagree with moving time expressions (15% when the expression is positive and 45% when the expression is negative).

Third, in contrast to experiment 1, we found no correlation between agreement to moving time expressions and endorsing a dynamical or non-dynamical theory of time.

Fourth, in contrast to experiment 1, we found no correlation between agreement to moving ego expressions and endorsing a dynamical or non-dynamical theory of time.

Tables 4 and 5 report levels of agreement to positive and negative expressions, respectively. Recall that the latter are reverse-coded, and that weak agreement is reported as agreement.

Table 4. Levels of agreement to positive expressions.

	%Yes	%No	%4	Mean	SD	t-value	p-value
Moving Time Expressions	79.5	15.9	4.6	4.99	1.15	15.687	<.001
1) It feels like the future is ahead of me, and it is moving towards me.	75.9	17.7	6.4	5.10	1.49	13.369	<.001
2) It feels like the past is behind me, and it is moving away from me.	78.3	15.9	5.8	5.19	1.50	14.323	<.001
3) It feels like time is a moving river that I am floating upon.	70.4	23.2	6.4	4.85	1.64	9.439	<.001
4) It feels like time is whizzing towards me.	63	28.4	8.6	4.63	1.70	6.694	<.001
5) I can feel time passing.	81.4	11.6	7	5.32	1.41	17.015	<.001
6) It feels to me like the present moves.	69.7	21.1	9.2	4.88	1.60	9.952	<.001
Moving Ego Expressions	84.7	10.4	4.9	5.30	1.13	20.708	<.001
1) It feels like I am moving through time, away from the past and towards the future.	82.9	12.5	4.6	5.34	1.34	18.040	<.001
2) It feels like the future is ahead of me and I am moving towards it.	83.5	11.6	4.9	5.46	1.40	18.859	<.001
3) It feels like the past is behind me, and I am moving away from it.	81.4	13.1	5.5	5.25	1.41	15.992	<.001
4) It feels like time is a road, and I am in a moving vehicle travelling along that road.	80.7	14.1	5.2	5.15	1.44	14.474	<.001

As in experiment 1, we find that the mean for each expression is significantly above 4.

Table 4a presents the same data, divided into those who strongly agree, strongly disagree and neither strongly agree nor disagree.

Table 4a. Levels of agreement to positive expressions reported as strong agreement/disagreement and neither strong agreement nor strong disagreement.

	%SA	%SD	%N
Moving Time Expressions	54.4	4.6	41
1) It feels like the future is ahead of me, and it is moving towards me.	44.6	7	48.4
2) It feels like the past is behind me, and it is moving away from me.	49.8	7.6	42.6
3) It feels like time is a moving river that I am floating upon.	43.4	11.9	44.7
4) It feels like time is whizzing towards me.	37.3	14.7	48
5) I can feel time passing.	51.1	5.5	43.4
6) It feels to me like the present moves.	40.4	11	48.6
Moving Ego Expressions	64.5	1.5	34
1) It feels like I am moving through time, away from the past and towards the future.	51.7	4.6	43.7
2) It feels like the future is ahead of me and I am moving towards it.	57.2	5.2	37.6
3) It feels like the past is behind me, and I am moving away from it.	48.3	6.1	45.6
4) It feels like time is a road, and I am in a moving vehicle travelling along that road.	45.9	8.3	45.8

Table 5. Levels of agreement to negative expressions.

	%Yes	%No	%4	Mean	SD	t-value	p-value
Moving Time Expressions	51.4	44.3	4.3	4.06	1.57	0.746	.456
1) It does not feel like the future is ahead of me, and it is moving towards me.	45	48.6	6.4	4.04	1.93	0.401	.689
2) It does not feel like the past is behind me, and it is moving away from me.	50.2	43.1	6.7	4.26	1.92	2.419	.016
3) It does not feel like time is a moving river that I am floating upon.	45	47.4	7.6	3.97	1.85	-0.328	.743
4) It does not feel like time is whizzing towards me.	37.3	54.4	8.3	3.69	1.84	-3.000	.003
5) I cannot feel time passing.	56	39.1	4.9	4.41	1.95	3.829	<.001
6) It does not feel to me like the present moves.	45.6	48	6.4	4.02	1.91	0.145	.885
Moving Ego Expressions	50.5	44	5.5	4.14	1.69	1.467	.143
1) It does not feel as though I am moving through time, away from the past and towards the future.	48.3	45	6.7	4.17	1.96	1.526	.128
2) It does not feel like the future is ahead of me and I am moving towards it.	49.8	45.6	4.6	4.21	1.97	1.908	.057
3) It does not feel like the past is behind me, and I am moving away from it.	49.3	44.3	6.4	4.13	1.96	1.187	.236
4) It does not feel like time is a road, and I am in a moving vehicle travelling along that road.	45.9	47.4	6.7	4.05	1.85	0.448	.654

Not all of the means are significantly different from 4. We find similar results for moving time expressions as we did in experiment 1. In this experiment we found that only moving time expressions (2), and (5), have mean responses significantly above indifference, while the mean response to moving time expression (4) is significantly *below* indifference (that is, what looks like indifference is really weak disagreement). In

experiment 1, however, the means for all the moving ego expressions were significantly above 4, and in this experiment none of them differ significantly from indifference. We can see, from comparing the means for moving ego expressions across both experiments, that those in experiment 1 are just *slightly* higher than those in experiment 2, which is just enough to make the difference between a significant difference and no such difference, from indifference. This tells us that the significant difference we find in experiment 1 is not very robust over different groups of subjects: we don't find similarly significant results in experiment 2, which has different participants.

Table 5a. Levels of agreement to negative expressions reported as strong agreement/disagreement and neither strong agreement nor strong disagreement

	%SA	%SD	%N
Moving Time Expressions	30	8.9	61.1
1) It does not feel like the future is ahead of me, and it is moving towards me.	28.7	27.5	43.8
2) It does not feel like the past is behind me, and it is moving away from me.	33	24.5	42.5
3) It does not feel like time is a moving river that I am floating upon.	27.8	28.4	43.8
4) It does not feel like time is whizzing towards me.	22.6	34.3	43.1
5) I cannot feel time passing.	38.5	23.5	38
6) It does not feel to me like the present moves.	27.2	28.4	44.4
Moving Ego Expressions	34.6	7.3	58.1
1) It does not feel as though I am moving through time, away from the past and towards the future.	32.7	27.2	40.1
2) It does not feel like the future is ahead of me and I am moving towards it.	35.5	27.5	37
3) It does not feel like the past is behind me, and I am moving away from it.	32.7	28.7	38.6
4) It does not feel like time is a road, and I am in a moving vehicle travelling along that road.	27.8	25.4	46.8

Pearson's correlation coefficients were again calculated between levels of agreement for all 4 kinds of expression. The results are summarised in Table 6 below.

Table 6. Correlation matrix for levels of agreement for positive and negative expressions.

		Positive		Negative	
		Moving Time	Moving Ego	Moving Time	Moving Ego
Positive	Moving Time	-	.77**	-.01	-.08
	Moving Ego		-	.14*	.18**
Negative	Moving Time			-	.89**
	Moving Ego				-

N.B. * $p < .05$ ** $p < .001$

In addition to the correlations noted at the beginning of this section, we once again found a weak correlation between people's levels of agreement to positive moving ego expressions and negative moving ego expressions. It is noteworthy that unlike experiment 1, we found no association between people's levels of agreement to positive moving time expressions and negative moving time expressions.

Of the original 327 participants, 164 participants correctly answered at least 2 of the 3 comprehension questions, and the following results include only these participants.

However, the results are robust: rerunning the analyses with *all* participant responses does not alter the main results.

58 participants were non-dynamists, who judged that the non-dynamical world—the B-theoretic universe—was most like the actual world. 106 participants were dynamists, who judged that the dynamical world—the growing block universe—was most like the actual world. There was no significant difference in confidence between non-dynamists ($M = 5.22$, $SD = 1.48$) and dynamists ($M = 5.04$, $SD = 1.50$; $t(162) = 0.766$, $p = .445$).

Level of agreement was analysed using a repeated-measures ANOVA. The ANOVA included a within-subjects factor of passage expression (moving time; moving ego) and expression form (positive; negative) and between-subjects factor of theory of time (non-dynamism; dynamism).

The 2x2x2 repeated-measures ANOVA revealed a main effect of expression form $F(1, 162) = 23.642$, $p < .001$, $\eta_p^2 = .127$, and passage expression $F(1, 162) = 29.846$, $p < .001$, $\eta_p^2 = .156$. There was also a significant interaction between passage expression and expression form $F(1, 162) = 12.304$, $p = .001$, $\eta_p^2 = .071$. There was no main effect of theory of time $F(1, 162) = .536$, $p = .465$.

The main effect of passage expression showed that there were higher levels of agreement to moving ego expressions ($M = 4.84$, $SD = 1.68$) than to moving time expressions ($M = 4.53$, $SD = 1.52$).

The main effect of expression form revealed that overall levels of agreement were significantly higher for positive expressions ($M = 5.01$, $SD = 1.65$) than for negative expressions ($M = 4.36$, $SD = 2.23$).

By contrast to experiment 1, there was no main effect of theory of time (or interaction effect involving theory of time). Participants responded similarly to all the expressions we presented, irrespective of whether they were dynamists ($M = 4.75$, $SD = 1.04$) or non-dynamists ($M = 4.62$, $SD = 1.04$).

Simple effects tests using a Bonferroni correction were carried out on the two-way interaction between expression form and passage expression.

For positive expressions, levels of agreement to moving ego ($M = 5.23$, $SD = 1.24$) were significantly higher than to moving time ($M = 4.80$, $SD = 1.24$; $p < .001$). For negative expressions, levels of agreement to moving ego ($M = 4.44$, $SD = 1.69$) were significantly higher than to moving time ($M = 4.27$, $SD = 1.58$; $p = .033$).

For moving time expressions, levels of agreement for positive expressions were significantly higher than for negative expressions ($p < .001$). For moving ego expressions, levels of agreement for positive expressions were significantly higher than for negative expressions ($p < .001$).

III. Discussion

In §I we outlined what we took to be natural predictions from the various views regarding our purported passage phenomenology. To be clear, however, none of these views *entail* that these predictions obtain. For instance, we noted that the veridical dynamist ought predict that people will strongly agree, with little variability, that it seems as though time passes. But of course, veridical dynamism could be true, and yet that prediction not be borne out: perhaps for instance, people believe that time does *not* pass,

(because they think physics tells them so) and hence they are disinclined to describe their phenomenology in these terms. In fact, our results would undermine this explanation, but the general point remains. With that caveat in mind, there are five key findings from these two experiments.

First, our results do not support the hypothesis that people will strongly agree to moving time expressions, with little variability. While approximately three quarters of our participants agreed with *positive* moving time expressions, just over half of our participants agreed with *negative* moving time expressions. (Recall that, due to our reverse-coding, agreement in both cases indicates agreement that it seems as though time passes.) The discrepancy between these results may be due to *acquiescence bias*: a tendency to provide affirmative responses to statements, regardless of their content.²⁶ It is plausible that responses to positively framed questions might over-estimate people's judgements, while responses to negatively framed questions might under-estimate people's judgements. We think it likely that the proportion of people who *in fact* agree that things seem as stated by these expressions lies somewhere in between half and three quarters.

Moreover, as we noted in our results, those who report weak agreement (such as, a Likert response of 5) are reported as agreeing in the above proportions. Thus it is perhaps more illuminating to focus on mean responses. Experiment 1 found mean agreement of 4.74 to positive and 4.34 to negative expressions, while experiment 2 found mean agreement of 4.99 to positive and just 4.06 to negative expressions. For each expression presented positively, we find that the mean level of agreement is above 4, and significantly so, in both experiments (people do weakly agree to these expressions). When we presented the expressions negatively, in experiment 1 we find that in only 4 of the 6 expressions do we find a mean level of agreement that is statistically significantly different from a mean of 4, and in experiment 2 we found that only 2 of 6 expressions are such that the mean level of agreement is significantly greater than 4, and 1 expression has a mean level of agreement significantly lower than 4. In that latter case the mean reveals that participants in fact overall weakly *disagree* that things seem as though time moves in the way described by that expression.

When we divide our participants into those who strongly agree, strongly disagree, or neither strongly agree nor strongly disagree, we see that when presented with the expressions in positive form, ~50% of participants (in experiment 1) and ~41% of participants (in experiment 2) neither strongly agree nor disagree to the moving time expressions. When we look to the expressions when presented in their negative form, we find that ~60% of people neither strongly agree nor disagree to moving time expressions across both experiments. In all, this suggests that people only weakly agree to moving time expressions. We also think that there is relatively little variability in participant responses. What we do not find, for instance, is a high percentage of people strongly disagreeing, and a high percentage strongly agreeing. Instead, we see most people clustered around neither strongly agreeing nor strongly disagreeing (between 41% and 61% across both experiments). Moreover, we see that the average standard deviations across all the moving time expressions fall between ~1.2 and ~1.5 across both experiments, again suggesting that there is not a high degree of variability in responses.

²⁶ See Schuman, H. & Presser, S. *Question & Answers in Attitude Surveys. Experiment of Question Form, Wording, and Context*. San Diego: Academic Press, 1981) and Holbrook, A. "Acquiescence Response Bias", in Lavrakas, P. J. (ed.) *Encyclopedia of Survey Research Methods*. (Los Angeles: Sage, 2008), Vol. 1, 3-4.

This is a striking result. As we discussed in our introduction, parties with very different views about the nature of time and temporal experience all take themselves to be obliged to explain why people overwhelmingly report strongly feeling as though time passes. The weak agreement we find calls for different explanatory strategies.

Second, we found no support for the hypothesis that higher levels of agreement with moving time expressions will be correlated with endorsing dynamism. Experiment 2 tested this hypothesis in the context of a growing block theory, and found no correlation. Experiment 1 tested this hypothesis in the context of a presentist dynamical theory, and found the surprising result that the greater the extent to which people agree to moving time expressions, the more likely they are to endorse a *non-dynamical* theory of time. Though this is a statistically significant effect, the effect size itself is small.²⁷ Still, this is a counterintuitive result.

Third, we found mixed support for the hypothesis that higher levels of agreement with moving ego expressions will be correlated with endorsing non-dynamism. Experiment 1 vindicated this hypothesis in the context of a presentist dynamical theory, though the effect size itself is small. Experiment 2 tested this hypothesis in the context of a growing block dynamical theory, and found no statistically significant association between agreeing to moving ego expressions, and endorsing either theory of time.

Fourth, we found that participants more strongly agreed to moving ego expressions than moving time expressions. Fifth, we found a strong positive correlation between agreement to positive expressions of each kind and negative expressions of each kind. Given the apparent effect of acquiescence bias, we take these findings to indicate that there is a single, ambiguous, phenomenology—ambiguous in terms of its character—that is driving people’s responses to both moving time and moving ego expressions, though it is somewhat better captured by moving ego expressions.

If one is a representationalist, then if the character of the phenomenology is ambiguous, then its content is ambiguous, which is just to say that it is ambiguous how our phenomenology represents things to be. For instance, it might be that the state is ambiguous between representing that the world is dynamical, and representing that it is non-dynamical. Similarly, if one is an anti-representationalist then one could think that while the content of the phenomenology is unambiguous, it has an ambiguous character. Call this class of views the *ambiguous content/character hypothesis*.

The anti-representationalist might instead think that neither the phenomenological content nor the character is ambiguous, but that it is ambiguous what that phenomenal character tells us about the world. For instance, the phenomenal character of our experiences might unambiguously be ‘flowy’, yet it might nevertheless be ambiguous whether these experiences suggest that our world is dynamical or non-dynamical. Call this the *character/world ambiguity hypothesis*. Let us call the claim that there is ambiguity somewhere, either in the content or character of the phenomenology, or in what its character tells us about the world, the *ambiguity hypothesis*.

The ambiguous content/character hypothesis explains why people’s levels of agreement to moving time and moving ego expressions is quite weak. It could be that participants weakly agree *both* that it seems as though time moves, *and* that the ego moves precisely

²⁷ $\eta_p^2 = .026$. Recall that partial eta squared values around 0.01 are considered small effect sizes, while values around 0.06 are considered medium effect sizes.

because their phenomenology has ambiguous content or character. If the character/world ambiguity hypothesis is correct, and the phenomenal character of our experiences is not itself ambiguous, then its character must be neither best described by moving time expressions, nor by moving ego expressions, but is partially captured by both. That is why we find weak levels of agreement to both kinds of expression.

In either case, the ambiguity thesis seems to be supported by the fact that we find different responses to both moving time and moving ego expressions depending on whether they are presented in positive or negative form. In both cases we find that when presented in the negative form, for at least some expressions, mean responses are not significantly different from 4, while the positive form of the expression always generates a mean level of agreement significantly above 4. Indeed, while we see a robust framing effect here (it matters which form of the question people receive) we also see that in some cases finding means significantly above 4 is not robust across different groups of participants. In the case of the negatively framed moving ego expressions, we find that responses that are significantly above 4 across the board in experiment 1, yet uniformly fail to be significantly different from 4 in experiment 2. This suggests that the significance, here, is not very robust, and further points to there being no strong, clear, phenomenology as of either moving time or moving ego.

While some of the difference that is due to the framing effect is likely to be explained by acquiescence bias, it seems plausible that the reason the framing of the expression has such an effect on people's responses is, in part, because there is ambiguity either in the content or character of the phenomenology, or in what its character tells us about the world. Hence participants resolve the ambiguity, in part, by being led by the framing of the expression.

Moreover, the ambiguity hypothesis nicely explains why we did not find that dynamists are more likely to agree to moving time expressions and non-dynamists are more likely to agree to moving ego expressions. (Experiment 2 found no correlation, while experiment 1 found that non-dynamists agree more strongly to *both* kinds of expression, though the effect size is small; more on this below). This is what we would expect if it is unclear what our experiences tell us about whether the world is dynamical or not. In addition, the absence of these correlations suggests that it is not the case that dynamists are interpreting their phenomenology as moving time phenomenology and non-dynamists are interpreting it as moving ego phenomenology. (It also undermines the suggestion that people might be failing to endorse moving time expressions because they think that time does not in fact pass).

Given this, since participants more strongly agree to moving ego than to moving time expressions, it might be better to call the contested phenomenology 'purported moving-ego phenomenology' rather than 'purported passage phenomenology'. That is important since, as we noted earlier, some veridical non-dynamists have presented accounts of why we have veridical moving-ego phenomenology in a non-dynamical world, in terms of the embedded perspectives of selves at times.²⁸ If our purported passage phenomenology is really purported moving-ego phenomenology, then arguments from the existence of this phenomenology, to the existence of temporal passage, are undermined by the availability of these accounts.

²⁸ See Ismael, J. "Decision and the Open Future." *op. cit.* and Callender, C. *What Makes Time Special?* (Oxford: Oxford University Press, 2017.)

Overall, we tentatively suggest that our findings are more consistent with the predictions made by the representationalist veridical non-dynamist, than by the veridical dynamist, anti-representationalist veridical non-dynamist, or the illusory passage theorist. The former predicted that insofar as people's responses have little variability, they will neither strongly agree, nor strongly disagree, with moving time expressions. That—in the form of weak agreement—is what we found. By contrast, the latter views all predicted that, with low variability, people will strongly agree with moving time expressions. This is not what we found.

Of course, that is not say that the results are not consistent with any of the other views. Veridical dynamists and illusory passage theorists might maintain that we have an unambiguous, strong, phenomenology as of time passing, and anti-representationalist veridical non-dynamists might maintain that our experiences have an unambiguous, strong, phenomenal flowy character, but for some reason neither of these is reflected in the strength of people's responses to the various expressions.

However, the expressions with which our participants were presented are written in very plain English using every-day terms and metaphors. Indeed, they are precisely the metaphors that dynamists use to describe their own experiences. If there is a strong, unambiguous phenomenology as of time passing, or a strong unambiguous flowy character to our experiences, it is not clear why people would not report this. Thus, at this stage of inquiry, some version of representationalist veridical non-dynamism provides the better explanation of our results.

Having said that, we noted earlier that some representationalist veridical non-dynamists think that a naïve belief in a dynamical theory of time causes misreporting of our ambiguous non-passage phenomenology. They thus contend that people who more strongly agree with moving time expressions are more likely to be dynamists. Our results undermine that contention. Importantly, though, representationalist veridical non-dynamists typically suppose there to be such a correlation *because* they assume that many people will report strongly agreeing that it seems to them that time passes. These assumed reports are explained by appealing to a further assumption—that many of us have a dynamical theory of time. In the absence of there being any such reports to explain away, however, these theorists can simply allow that our ambiguous purported passage phenomenology is more or less equally likely to bring it about that we have a dynamical theory of time as a non-dynamical theory of time: indeed, that fits rather better with the veridical non-dynamist's view about that phenomenology.

What, then, explains the lack of correlation (and the surprising correlations) between people's levels of agreement to moving time and moving ego expressions, and their endorsing either dynamism or non-dynamism? Three candidate explanations spring to mind.

The first is that we do not see dynamists more strongly agreeing to moving time expressions because, while there is a substantial subpopulation who have a phenomenology as of time passing, which suggests to them that time does pass, these people nonetheless predominantly come to endorse a non-dynamical theory of time on the basis of explicit knowledge about our world. While their phenomenology recommends in favour of dynamism, for these people there will be no correlation between explicit theory and reported phenomenology. We cannot rule out that there are

such people. Notably, however, a recent study found no correlation at all between people deploying either a dynamical or a non-dynamical tacit theory of time, and their levels of education and knowledge of physics.²⁹ This suggests that there is not a large group of people whose phenomenology suggests that our world is dynamical, but who nevertheless possess a non-dynamical theory of time.

The second candidate explanation is that our purported passage phenomenology simply plays no role in *bringing about* (either by directly causing, or by providing reasons to adopt) our theory of time. This explanation is consistent with the results of experiment 2, where we found no correlation between agreement to moving time/moving ego expressions, and endorsing a dynamical or non-dynamical theory of time. However, it is no explanation of the results of experiment 1, which found that the greater the extent to which people agree to moving time expressions, the more likely they are to have a *non-dynamical* theory of time. Moreover, it found that that the greater the extent to which people agree to moving ego expressions, the more likely they are to have a non-dynamical theory of time. If our purported passage phenomenology plays no role in bringing about our theory of time, then we would not expect these correlations. That gives us reason to reject that explanation.

The third candidate explanation is that our purported passage phenomenology does play a role in bringing about our theory of time, but because the ambiguity hypothesis is true, it is roughly equally likely to bring it about that we adopt a dynamical theory as that we adopt a non-dynamical theory. To put it another way, the phenomenology is equally consistent with a dynamical theory as with a non-dynamical theory. This explanation is consistent with our findings in both experiments. If the ambiguity hypothesis is true, and our purported passage phenomenology can be described by both moving time and moving ego expressions, then while it might provide equal reason to adopt either a growing block or eternalist theory of time (as per experiment 2) it might not provide equal reason to adopt either a presentist or eternalist theory of time (as per experiment 1). It could be that the phenomenology recommends in favour of eternalism over presentism, but recommends neither the growing block theory nor eternalism over the other.

It is surprising that it recommends in favour of eternalism over presentism, even bearing in mind that this effect is small. Interestingly, at least one presentist argues that presentism is not a view on which time passes.³⁰ Perhaps, although most philosophers think of presentism as a paradigmatic model in which time passes, this is not how it seems to non-philosophers, and so they think that eternalism, to some small degree, is more consistent with their purported passage phenomenology than is presentism. At this point we don't have enough data to speak to this issue, but these results are interesting, and suggestive.

Ultimately, then, our results suggest is that there is no overwhelming need for philosophers of time to attempt to accommodate the presence of some unambiguous, and strongly felt, phenomenology as of time passing. This is a notable result, for as we outlined in sections 1 and 2, much ink has been spilled trying to accommodate phenomenology of this kind. Our results suggest that there is no such unambiguous and strongly felt phenomenology and that what phenomenology there is, is felt by people

²⁹ Latham, A. J, Miller, K. & Norton, J. "Is our naïve theory of time dynamical?" *op. cit.*

³⁰ See Tallant, J. (2012). "(Existence) Presentism and the A-theory." *Analysis*, LXXII(4): 673-681..

regardless of whether they endorse a dynamical or non-dynamical theory of time. Hence arguments from the existence of our purported passage phenomenology to the conclusion either that time passes³¹ or to the conclusion that our phenomenology is systematically illusory, since it represents something—time passing—which does not exist are ill-motivated. Further, we see little reason, arising from people’s reported phenomenology, for veridicalist non-dynamists to posit the existence of some pervasive, ubiquitous, ‘flowy’ phenomenal character to our experiences that outstrips their representational content, given that that phenomenal character is posited precisely to explain why people are inclined to say that it seems to them as though time passes.

IV. Conclusion

Our experiments suggest that the widely accepted assumption, amongst philosophers, that it unambiguously, and strongly, seems to people as though time passes, is an assumption that might need to be jettisoned. If so, that has important implications for philosophical theorising about the connection between our phenomenology and the metaphysics of time, work that we hope to take up in the future.

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³¹ For arguments of this kind see Smith, Q. “The Phenomenology of a-Time.” *op. cit.*, Craig, W. L. *The Tensed Theory of Time: A Critical Examination*, *op. cit.*, and Schlesinger, G. N. *Timely Topics*, *op. cit.*

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