

On the Question: How Fast Does Time Pass?¹

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Abstract

In this paper, I take up the question of “how fast does time flow?” This question is usually asked as a rejoinder to the view that time is irreducibly tensed, which is motivated by the fact that we experience the passage of time. I consider what the meaning of this question could be and provide a defence of the view that the passage of time is meaningless (due to its rate of passage being dimensionless), undercutting the motivation for a tensed view of time.

1 Introduction

“There are philosophers who think that some views about the nature of time can be refuted just by asking this question (in the right tone of voice). Others think the question has an obvious and boring answer”

(Skow, 2011)

Does time “pass” or “flow”? If so, how fast does it go? These questions are instances of a particularly difficult sort of philosophical question. Such questions’ meaning or significance is not initially clear. Naturally then, one may wonder whether the question has any meaning or significance at all. It may be that it is a mere misuse of language. However, this version of the questions at hand may be too abrupt. Our subjective experience gives us reason to believe that there is some truth to the statement that time flows (Maudlin 2007, Paul 2015 and 2010). This experience is often used as motivation for a so-called A-theory of time in which the present is somehow metaphysically privileged over the past and future. The present is defined, in part, by the fact that events flow from future to present and into the past.

If one takes the expression of time’s flow to be more than metaphorical, as A-theorists tend to, then one would believe that the question of the speed of this flow would be well-formed and answerable (as it is for other flows, like a river)³. This has provided the grounds for a modus-tollens argument against the A-theorist. Thus, the question is nonsensical, as the only plausible answer is meaningless, and so time cannot be said to flow at all. In this paper I will lay out expositions of the question’s possible meaning

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³ After all, if there was no speed (i.e. 0), then time would not be flowing at all.

and ultimately argue that it is indeed without meaning, providing a problem for the non-metaphorical A-theorist.

2 Establishing the Meaning of the Question

In order to understand the meaning of the questions “Does time pass?” and “How fast?” we should first ascertain what it would mean to answer the first question in the affirmative. This is because the latter question only makes sense if the former does. Markosian (1998) provides a definition of what it means to affirm the passage of time. To say that time passes is to commit to the “passage thesis”:

Passage Thesis: “Time is unlike the dimensions of space in at least this one respect: there are some properties possessed by time, but not possessed by any dimension of space, in virtue of which it is true to say that time passes.” (Markosian, 1998, 2)

Markosian characterizes the passage of time as making time *distinct* from space (i.e. there are properties of time that are not possessed by any dimension of space). It is due to these properties that it is appropriate and true to say time passes and space does not.

We can flesh out this characterisation in the following way. Asserting the passage thesis commits Markosian to two further theses, the first semantic, the second metaphysical:

The Tensed Conception of Semantics: Propositions have truth-values at times and tenses (past, present, and future) that are ineliminable and fundamental (Markosian, 1998, 2).

A-Property Thesis: Events have monadic tense properties (being present, being past, being future) that are not to be analyzed in terms of relational B-properties, they are properly basic.

To provide a picture of what these two theses commits one to, consider an event, E. For example, the event of me submitting this paper for review. Say, at time $t=0$, that E has not yet occurred and will occur at $t=1$, then E would have the property of being future: $F_{t=0}(E)$. At this time, proposition P, ‘E is occurring,’ is false (note the present tense of the verb occurring), while the proposition P*, ‘E will occur,’ is true (again, not the ‘will’). Then consider how this picture changes at time $t=1$, when I am submitting this paper. At $t=1$, E has the property of being present: $P_{t=1}(E)$, P becomes true and P* becomes false.

In sum: A present tensed proposition regarding some event is true at some time if and only if that event is present at that time and false otherwise. A past tensed proposition regarding some event is true at some time if and only if that event is past at that time and false otherwise. A future tensed proposition regarding some event is true at some time if and only if that event is future at that time and false otherwise⁴.

⁴ There are, of course, more sophisticated A-properties and tenses, e.g. 5 days from now, now and forever, etc., I leave aside such complications as they are irrelevant to the purposes of this paper.

The third thesis that Markosian takes to be part of a commitment to the assertion that time passes is the pure passage of time thesis:

Pure Passage of Time Thesis: Times and events inexorably have different A-properties successively, this is what the passage of time consists of (Markosian, 1998, 8-9).

This is what gives time its flow; events future become events present and events present become events past. *Prima facie*, Markosian presents an intuitive correspondence theory of the passage of time: events successively change their tense properties and as such claims about them change their truth-value relative to the change in the events properties. It is not, however, the final word on the meaning of time's passage.

Van Cleve (2011) takes issue with Markosian's (1998) exposition of the meaning of time's passage and presents an alternative view from Prior. Prior sees the tensed conception of semantics as optional for the passage of time, and does not accept the A-property thesis (and further denies that the former implies the latter) (Van Cleve, 2011, 143). In Prior's tense logic, tenses are substitutes for A-properties rather than mere semantic analogues. Rather than taking tenses to be properties attached to events, they are sentential operators, acting similarly to modal operators (i.e. tenses are adverbial rather than predicative) (ibid, 142-143). This avoids a commitment to events in the semantics; rather than needing actual events that *have* A-properties for a tensed statement about that event to be true, one can merely make a semantic claim about the truth-value of some sentence⁵.

Van Cleve then presents Prior's arguments that Markosian's semantics is rooted in an assumed (and I think, mistaken) ontology. For Prior, there are no time "entities" (ibid, 143); the Newtonian assumption that times exist independently of events in the world is unnecessary to the establishment of the meaning of times passage. Markosian makes a similar mistake with respect to time as Heidegger warned us against with respect to Being⁶; Time itself is not a being, it is a category mistake to assign properties, in this case A-properties, to it as if it is. Prior's tense logic "lets us express truths about the topological structure of time without committing ourselves to Time as an entity" (Van Cleve, 2011, 7)⁷.

So what, then, is a less ontologically presumptuous reading of the passage of time? The passage of time is, for Prior, the mere idea that truth values change in time. And so we get Markosian's semantic claim, without the metaphysical baggage of times and events, nor a correspondence theory of tense. In response to the further question of the rate of time's passage, Prior, perhaps facetiously, proffers the simple answer: a second per second (ibid, 163).

⁵ This is a similar move as Tarski's T-Schema. A supposedly ontologically neutral semantic analysis. Van Cleve admits as much by suggesting it can avoid liar-like paradoxes (Van Cleve, 2011, 4).

⁶ "Being is not itself a being", See the first two chapters of Heidegger (1962)

⁷ Maudlin (2007) too gives in to this temptation, he takes these topological truths to be law-like and wants to include the fundamental laws of physics into his ontology. It seems like this argument may turn on whether one believes that descriptions require a target *object*.

Now that we have some formulations of what it means to ask “Does time pass?” as well as a suggestive answer to the further question “How fast?” I shall move to a discussion of the meaning, or meaninglessness, and some answers to the latter question.

3 The Incoherence of the Rate of Time’s Passage

Assuming one has convinced an interlocutor that the passage of time is at least not initially nonsensical, the interlocutor may naturally push and ask: At what rate does it pass? The common analogy is between the “flow” of time and the “flow” of a river. Certainly a river flows at some definite, perhaps variable, non-zero rate, so too, must time, if the analogy is to hold. If there is no such coherent flow rate for time’s passage, then time cannot be said to truly pass at all. Markosian argues that the question of “how fast does time pass?” arises from these principles:

Rate Principle: For any x, if x changes/passes, then it changes/passes at some rate. (A rate is a ratio between a parameter or metric of measurement and a unit of time.) (Markosian, 1998, 13)

Coherence Principle: For any x, if some x flows or passes, then it is possible to state coherently the rate at which x flows or passes. (Markosian, 1998, 14)

Markosian then lays out some possible strategies for measuring rates in order to show that in each case there is a way out of arguments against there being a rate of passage for time. I will use Van Cleve’s (2011, 11-12) distillation of these three possible strategies: (1) a rate may be measured by comparing to any other rate; (2) a rate of change can only be measured in comparison to the rate of the passage of time, either (2a) the pure passage of time can be measured in comparison with itself, or (2b) it makes no sense to assign a rate to the pure passage of time.

A common objection to the pure passage of time thesis arises from accepting (2) but denying (2a) and (2b); the pure passage of time must be measured by *another* external time dimension. As the external time dimension (commonly called hyper-time) must also pass in reference to a higher time dimension, there is a threat of infinite regress to this strategy⁸. However, I want to set this argument aside. Markosian believes that his interlocutors have not shown that he should accept the premise that time’s rate of measure must be compared to an external (hyper)time dimension and so he denies it. I agree that there is no motivation for this premise; there are plenty of rates of change that have nothing to do with time (e.g. exchange rates, elevation rates), so why would time’s rate of change have an extra constraint on what it can be compared to? However, the A-theorist needs the flow of time to be a property unique to it and not shared with space. So then the question *really* is: what’s special about time?

If we deny that the rate of time’s passage must be compared to an external (hyper)time dimension, we may then claim that the rate of passage of time can be measured by comparing it to a “mundane” process (Van Cleve, 2011, 12); this is strategy (1). For example, the fact that that a person is running at a rate of 12 miles per hour can be

⁸ See Skow (2011) on the ensuing debate regarding this argument.

flipped into the fact that time is passing at a rate of one hour per 12 miles run by this same person. However this does not get us the direct measurement of the pure passage of time. What is an hour? It is a measure that is defined by some other mundane process (one 1/24th of the period of the sun's rotation in the sky). In measuring rates, we are always comparing the changes of some phenomenon to the changes of some other phenomenon (e.g. distance travelled by a runner versus distance travelled by clock hands). Generally we do not actually care about the second phenomenon and use it as a stand in for direct comparison with the passage of time itself. To have this strategy effectively answer the question of the rate of time's passage, one would need to postulate that some processes are more directly linked to the pure passage of time. What this privilege consists of needs to be supplied before this is anything more than conjecture.

If one takes strategy (2a), there is an issue of units. How fast does time pass? At a rate of one second per second. Van Inwagen and I both share the complaint that this cannot be a meaningful rate, the units cancel and the number (unity) is dimensionless. Such dimensionless quantities are meaningless, to say that time passes at the rate of one second per second is to say that time passes at a rate of six (or fifty-two, whatever number fits your fancy). Six what? Any physics student has it beat into them that if you do not attach units to your number then it tells us nothing physical. Maudlin (2007) argues, that while this rate of time's passage is indeed an *a priori truth*, it is not meaningless. He likens it to monetary exchange rates: 1 USD is worth 1 USD, but this is not vacuous. One must specify the units of the exchange, they do not, as it were, "cancel out." He distinguishes ratios from numbers, the former retain their unit measures (like π as the ratio between a circle's diameter and circumference) while the later do not have such units (the real number π). Ratios have an associated class of units, length for π , in the circumference–diameter case. And so the rate of time's flow – one second per second – is not vacuous as it "is a measure of how much something changes *per unit* time."

I think Maudlin is bit quick in his rejection of this objection. While the units may not "cancel out" and *do* say something about the formal constraints on the passage of time (it must be self-consistent), he ignores how truly vacuous tautologies are. Maudlin's constraint is merely that there be a use of the appropriate *kind* of units, both of these rates use solely temporal units. The former proposition, being a tautology at best, category mistake at worst, then does not tell us *anything* about the world. Nothing hangs on it, especially physically. A contrasting case will make this clearer. Consider the statement "a year passes every three hundred sixty-five days." A way of putting this mathematically would be with a ratio: $\frac{1 \text{ year}}{365 \text{ days}}$. The significance of such a ratio is linguistic, it allows us to translate values in terms of years into days and vice versa. One may object to this analysis. Don't 'year' and 'day' correspond to aspects of physical reality? A year is the length of time it takes for the Earth to complete a revolution around the Sun and a day is the length of time it takes for the Earth to rotate about its own axis. Therefore this ratio is not merely linguistic, but rather has physical significance!

There is a problem with this line of thought – or at least with these particular examples. Let's focus on one of them. Due to astronomical effects like precession and tidal forces, what we call a year is not exactly the duration of the Earth's solar rotation (the sidereal year). This is well-known and the reason we have leap-years every so often (to correct for the inaccuracies). Likewise with other measures (e.g. days). What does this show us?

It shows us that a change in the units, the ratios and terms we associate with certain phenomena need not correspond to physical reality in a robust way. Put differently, we could use a different value for year, say 365.25 days per year, and this would be of no physical significance: it would be more accurate to the phenomenon of the Earth's orbit, but it would not be more or less accurate in terms to the length of *time* itself (remember that days itself is a pragmatically chosen unit as well). Let's return to the ratio of one second per second. This is a translation from the language of seconds to the language of seconds, a completely isomorphic transformation. As such, it is completely trivial and could not have any physical significance⁹.

This takes us to the third strategy, (2b), which was suggested earlier by Prior, denying that it makes sense for the passage of time to have a rate. This can cut both ways, one can take this to show that there is a deeper incoherence in the notion of time passing as any passage should have a rate (as has been shown), or one can take it to show that the passage of time is a special sort of passage, one without any discernible rate. Van Cleve makes a distinction between absolute and comparative rates, the former being rates independent of any other rates and the latter being rates that are co-defining (e.g. monetary exchange rates). This distinction he gets from Newton's own distinction between absolute and relative motion. Relative motion is simple to understand, it is the change of position of one body relative to the change of position of another body, over some period of time (e.g. two ships passing one another). Thus, there is not no sense in which a body's relative motion can be defined without defining the relative motion of another body. Absolute motion, on the other hand, is the change of position of a body, over some period of time, irrespective of the motion of any other body¹⁰. For this to make sense, Newton needed a way to fix the initial and final positions of the body without reference to any other bodies, thus he introduced the concept of absolute space. This substratum gives each position in space a stable identity, allowing a change in position to be well-defined. Much like Newton, then, Van Cleve needs the postulation of some substratum that grounds the facts of absolute rates independent of any other comparative rates. Van Cleve suggests that we should again consider the pure passage of time to be this sort of absolute rate of change, leading us again to the tautological rate of one second per one second. He goes on to argue, that this does not even depend on the sort of substantialist view expressed above and criticized by Prior. Indeed, he shows how Prior's answer was a serious, and deflationary, response to the question "How fast does time pass?"

Again, I wish to reiterate my concerns. Perhaps it is not nonsensical to say that time passes at a rate of one second per second, but it is also not *saying* anything at all. It is, perhaps, *showing* what it means for time to pass, that is, that one second precedes the next and the truth-value of certain tensed (metrically or otherwise) propositions changes with time. This however ignores why we wanted to establish the fact that time passes in the first place, it is supposed to be, as Skow puts it, *metaphysically interesting*. This is because it is supposed to motivate the dynamic theory of time against the attacks of the defenders of the static theory. So the A-theorist has a dilemma, which we started the paper with, they must establish their view on a nonsensical basis, a misuse of language, or say nothing at all.

⁹ It's important to note that I am only dealing with units and ratios that deal with the same kind of measurements. Transformations between say lengths and times (i.e. velocities) are physically significant

¹⁰ See Huggett (1999, 159-169) for more explication of this distinction and the problems it is designed to solve.

4 Conclusion

In this paper, I have attempted to make clear the meaning of the question: “How fast does time pass?” To do so, I first had to clarify what time’s passage may mean and what commitments come with its acceptance: either Markosian’s pure passage thesis or the deflated Priorian semantic thesis. I then delineate and respond to a number of possible strategies to answer the question coherently: (1) establishing the rate of time’s passage relative to the rates of other processes, (2) establishing the rate of time’s passage absolutely. The first strategy, I argue, fails by neglecting to establish what processes are to be reliable guides to the rate of time’s passage, and why. It also fails to explain why time’s passage is *special*, in a way the spatial rates of change are not. The second strategy, I argue, fails to establish anything physically or metaphysically interesting as the most promising candidate rate: one second per second is linguistically tautologous. The lack of any satisfying answer to the question: “How fast does time pass?” undercuts the motivation for a dynamic theory of time. The hope is that future motivations for dynamic theories of time are clearer and are clearly significant, providing a satisfactory answer to the question of how fast time passes.

References

- Heidegger, Martin. *Being and Time*. (7th ed.) Translated by J. Macquarrie and E. Robinson. New York: Harper Collins Publishing, 1962.
- Huggett, Nick. *Space From Zeno to Einstein: Classic Readings With a Contemporary Commentary*, Cambridge: MIT Press, 1999.
- Paul, L. A. “Experience and the Arrow.” In *Chance and Temporal Asymmetry*. Edited by A. Wilson. Oxford: Oxford University Press, 2015.
- Paul, L. A. Temporal Experience. *Journal of Philosophy* 107, no. 7 (2010): 333-359.
- Markosian, Ned. “How Fast Does Time Pass.” In *The Way Things Are: Basic Readings in Metaphysics*. Edited by W. R. Carter. New York City: McGraw-Hill, 1998.
- Maudlin, Tim. “On the Passing of Time.” In *The Metaphysics within Physics*. Oxford: Oxford University Press, 2007.
- Skow, Bradford. One Second Per Second. *Philosophy and Phenomenological Research*, 85 (2012): 377-389.
- Skow, Bradford. On the Meaning of the Question ‘How Fast Does Time Pass? *Philosophical Studies* 155, no. 3 (2011): 325-344.
- Van Cleve, James. Rates of Passage. *Analytical Philosophy* 52, no. 3 (2011): 141-170.