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## *Commentary*

# Going ‘Humean’ on the Flow of Time

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### Abstract

We argue that the problem of the flow of time is a special problem, one unlike many other challenges in reconciling temporal phenomena with time in physics. After clarifying this point, we develop a Humean account of the flow of time according to which the psychological stream of experience explains why we think the world is tensed. On our account, the flow of time is not all inferential, as the invitation to think time flows comes from the deepest aspects of human experience, making it an offer we cannot refuse.

### Keywords

time-like, worldline, change, succession, duration, Humean, block universe, flow

AQ1

Both target papers adopt a ‘divide and conquer’ approach to understanding time. Different features of time require different explanations. These explanations demand resources from different philosophical and scientific disciplines. So they both propose and mount all-out interdisciplinary and multifaceted attacks on time. To us that seems clearly the right way to make progress. Yet we worry that neither contribution goes into the depth required to explain or even to really see the problem of the flow of time. So it might be helpful to begin by charting some geography. After that we will propose our current favorite way of explaining time flow.

The physics relevant to human beings posits a lot of spatiotemporal structure. This structure provides well-defined spatiotemporal lengths to time like worldlines

like us and the objects with which we interact. Relative to a local reference frame, temporal properties such as change, motion, velocity, order, duration and more additionally make sense. If we include nonfundamental physics, such as thermodynamics, then we can add temporal direction. Physics then posits many temporal properties, including change, speed, velocity, motion, direction, succession and duration plus topological properties such as continuity, openness, and so on. Call these the *Uncontroversial Temporal Properties of Physics* (UTPP). They are uncontroversial in the sense that a wide consensus holds that physics attributes such structure to time, at least at energy scales relevant to human beings (see Note 1).

Both articles seem to think that there is some kind of problem with change and motion when understood on a ‘block’ manifold. Gruber *et al.* (2022) write that “[f]rom the viewpoint of physics motion is denied in the Block Universe” and Buonamano and Rovelli (2023), characterizing the view as ‘extreme,’ hold that the ‘block’ implies “no change, nor actual dynamics.”

AQ2

Fortunately, no serious defender of what’s sometimes called the B-theory of time has ever denied the existence of motion or change or actual dynamics. Quite the opposite. One of the fathers of the B-theory, Bertrand Russell, understood dynamics via the ‘at–at’ theory of motion (Russell, 1901), which reduced velocities to positions at times. More generally, change is having different properties at different times. Hence the block represents change, but “[c]hanges ... neither do nor do not change” (Smart, 1947, p. 488). We should not commit the intentional fallacy and confuse features of a representation with what is represented. In philosophy all of these points were clear long ago (Russell, 1915; Smart, 1947; Williams, 1951).

Just as we can say we have spatial experiences, such as perceiving an edge, we also have temporal experiences. Phenomenology, psychology and cognitive science agree on many of these experiences: sense of order, sense of duration, sense of change, sense of motion and many others. Call these the *Uncontroversial Temporal Properties of Experience* (UTPE). Again, by uncontroversial, we don’t mean that we fully understand them. Science is ongoing. What we mean is that a consensus exists that these are part of temporal phenomenology.

When UTPE track features in UTPP, we don’t have a huge ‘two times’ gap. True, as with any perception, things can go wrong. We might experience change even when viewing something lacking change, as in the waterfall illusion; or we might suffer from change blindness even in the presence of change. And as is common to all perception, many stimuli can modulate our experience of temporal properties, as when a visual flash affects when an audio beep is heard. Generally speaking, however, UTPE more or less veridically represents UTPP, just as pig experiences generally track pigs. Physically long durations tend to seem long, physically short durations short. It seems a mistake or at least odd to call all of our experiences of motion or duration or order illusory, as Gruber *et al.* (2022) do. We have ongoing

research and many puzzles, but these are the norm for anything in perceptual psychology.

By getting hung up on the block universe and illusions, the authors don't see how the problem of the flow of time is special. What makes it special? Simple — the flow of time is not obviously on either list, UTPE or UTPP. People think that there is a now that moves through time. And they believe that New Year's is coming up. In both cases they attribute to time a temporal deictic structure {past, present, future} and a deictic center given by a special Now (see Callender 2017). Both are important parts of our language, thought and behavior. But none of the above properties in UTPP convey by themselves any temporal deictic structure; so if by 'flow of time' we mean something connected to changing temporal deictic structure, then nothing in the UTPP is a flow of time. (For two recent empirical studies linking our flow attitudes to temporal deictic structure, see Shardlow *et al.*, 2021 and Latham *et al.*, 2020.) Worse, it's not even clear that *we experience* a flow, for the belief could arise from an inference or metaphor. It is sometimes held that we experience the present like we experience redness, but this claim is very hard to explicate (see Callender, 2008; Mellor, 1998).

How do we close the gap? Some would add to UTPP something flowy. Some metaphysicians and physicists select from a kind of bestiary of temporal metaphysical monsters something that flows, for example, a privilege absolute present. Objections are then made that these metaphysical add-ons conflict with physics in some way. Yet the main problem with this large class of positions is that not one of these suggestions have ever demonstrated how these additions could *explain* flow experiences (if they exist — but which are appealed to as justification for the addition) (see Callender, 2017, ch. 13).

To our mind more interesting, other philosophers add something flowy to UTPE. Torrenço (2017), for instance, thinks of flow as a phenomenal modifier of our mental lives, but the modifier does not represent the world as flowing nor does it add anything to UTPP.

Our hope is to be more conservative, to explain the flow of time without any additions to UTPP or UTPE. That is, we want to explain the flow with resources already on our lists, resources that are already posited for independent reasons. We believe that we have all the puzzle pieces we need. What makes assembling them hard is confusion over different explanatory targets.

Zooming way out, the key move is one that might be described as Humean. Recall that rationalists posited necessity in the world to explain how an object caused another to change. If a cue ball makes contact with an 8-ball in such a way as to sink the 8-ball in the hole, the cue ball necessitated the ball going in the hole. Famously, Hume flipped things around. He explained the necessity as the psychological property of expectation built up by seeing billiard balls execute such patterns over time. Instead of attributing to the world a property (necessity) he

posited that human beings have a tendency to paint the world a certain way due to some aspect of their experience.

It's not often put this way, but the core part of conservative explanations of the flow of time is the same. At any moment, we have a perceptual and introspective immediate present, an anticipated future, and a remembered past. This is so of the next moment, and the next moment, and so on. The Humean move is to project this experienced tripartite structure onto the world. Just as psychological expectation is not evidence of worldly necessity but constitutive of it for the Humean, the psychological stream of experience is not evidence of the flow but constitutive of it. There is no 'flow' structure in the world. The A-theorist thinks the world having tensed structure explains why we have this stream of experience, but the explanation, if we're right, is the reverse way around, for the stream explains why we think the world is tensed.

That's the big picture, but then there are many details to fill in. Callender (2017) spends a lot of time trying to show why it makes sense for organisms to have this flowing time model of the world (even if it does not reflect anything in UTPP) given physics and our biological and environmental context. Callender also explains how signal speeds, physics, biology, and cognitive science lock this tripartite structure up so that we enjoy great inter-subjective agreement about it, making us think it's an objective feature of reality. The updating of this structure is just the updating of this psychological structure along a worldline.

None of that explains why the stream seems like a stream. If the subject at time  $t_1$  divides the world into a temporal tripartite structure and the subject at  $t_2$  does too, there is no stream unless there is a subject who considers itself to persist through time. A crucial part of the story, then, is using Velleman's (2006) idea that the self is taken to persist through time. The subject at time  $t_1$  is the subject at time  $t_2$  (or at least take themselves to be). Relative to that subject, the tripartite division of the world changes. With these self-experiencing changing temporal deictic structures, we have flow. And using cognitive metaphor theory and the interchangeability of Ego-Moving and Time-Moving frames (see Callender, 2017), it's then no surprise that people might agree that the future is ahead of us and that it feels like it is moving toward us — or that we are moving through time, away from the past and toward the future.

Apart from the stream of experience, the above explanation more or less relies on the operation of our cognitive/inferential mechanisms. To many that seems unsatisfactory or incomplete. Reacting to Callender's above theory which appealed to a narrative theory of identity, Weatherall (2020) writes, "I do not understand how I can perform anything analogous to crawling to time by narration ... I am left feeling that something is missing." Could it really be that one of the most basic features of being human is due to projection and cognitive inferences about identity? If Craig stopped believing that Craig at time  $t_1$  is identical to Craig

at time  $t_2$ , would he stop feeling like he is passing through time, hurtling towards his inevitable death? The explanation might feel too ‘fancy’ or high-level.

We sympathize with this concern and feel that the above explanation needs to be supplemented with lower-level phenomenology and subpersonal processes. Work in this space is ongoing and we have little room, but lower-level processes complement the above picture. Here are a few ways to see that. The momentary psychological presents — what Ismael (2017) calls ‘TEMPs,’ for Temporally Embedded Momentary Perspectives — are temporally extended. Callender explains the apparent objectivity of these presents via constraints that create intersubjective agreement. That too seems very high-level. But note that the objectivity of the present has an experiential aspect to it, as Hoerl (2018) nicely describes. Unlike spatial perspectives, which present themselves as perspectives, temporal perspectives present themselves as lacking a viewpoint. When we look out at the world, there is a lot of evidence that the spatial picture we’re getting is just one of many. That’s not true of temporal perspective, which invites us to regard it as objectively special. This experiential feature is utterly uncontroversial, and hence it is part of UTPE.

Now peer inside these TEMPs. There you will find experiential selves. Sometimes called ‘minimal selves,’ these selves correspond to being the subject of experiences. There is a phenomenological experience of being a self, in the sense of an integrated functional state of the neural dynamics, which provides the body attention and control of itself (see Blanke and Metzinger, 2008, and references therein). Inside these temporally extended TEMPs is also a sense of agency. We make decisions and act on the world in one temporal direction rather than another. We do this within a temporal deictic structure. The sense of agency is also a sense, a phenomenological feature (see David *et al.*, 2008). We do not simply ‘own’ the experience when we are agents, but we feel (as opposed to merely judge) we are the event’s author. We string together selves cognitively, but at shorter timescales we are already automatically identifying these minimal experiential selves who act as agents. Both the sense of self and of agency are posited independently of solving the puzzle of time flow. By digging deeper into the resources UTPE contains, we can fill out the picture of why time seems to flow.

The flow of time is not all inferential. Students taught the Ship of Theseus paradox do not suddenly feel like time does not pass. They can’t. The reason for this is that the invitation to think time flows comes from the deepest aspects of human experience, making it an offer we cannot refuse.

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## Note

1. Of course there remains controversy in understanding all of these ‘uncontroversial’ features! Some of these features may not be found in quantum gravity. Others may admit of different interpretations, such as whether duration is understood substantially or relationally. What is uncontroversial is only that physics attributes these properties — however understood on a deeper analysis— to the world when describing the world at energy scales relevant to human beings.

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AQ4

AQ5

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- AQ1— Reference the two articles this remark is referring to.
- AQ2— The copy editor added two papers to the References which I suspect are the correct ones; please check and correct or confirm.
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- AQ4— Please note that the reference “Gruber et al. (2023)” is not cited in the text. Please provide an in-text citation for the reference.
- AQ5— Please note that the reference “Smart (1949)” is not cited in the text. Please provide an in-text citation for the reference.