

The Human Brain Is a Time Machine

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“Time” is the most common noun in the English language, Dean Buonomano tells us on the first page of his new book, [Your Brain Is a Time Machine: The Neuroscience and Physics of Time](#). But despite fixation with time, and its obvious centrality in our lives, we still struggle to fully understand it.

From a psychology perspective, for instance, time seems to flow by, sometimes slowly — like when we’re stuck in line at the DMV — and sometimes quickly — like when we’re lost in an engrossing novel. But from a physics perspective, time may be simply another dimension in the universe, like length, height, or width. Buonomano, a professor of neuroscience at UCLA, lays out the latest, best theories about how we understand time, illuminating a fundamental aspect of being human.

The human brain, he writes, is a time machine that allows us to mentally travel backward and forward, to plan for the future and agonizingly regret that past like no other animal. And, he argues, our brains are time machines like clocks are time machines: constantly tracking the passage of time, whether it’s circadian rhythms that tell us when to go to sleep, or microsecond calculations that allow us to hear the difference between “They gave her cat-food” and “They gave her cat

food.”

In an interview with Science of Us, Buonomano spoke about planning for the future as a basic human activity, the limits of be-here-now mindfulness, and the inherent incompatibility between physicists’ and neuroscientists’ understanding of the nature of time.

I finished reading your book late last night and went to bed sort of planning our interview today, and then woke up at about 3:30 a.m. ready to do the interview, with my head full of insistent thoughts about questions that I should ask you. So was that my brain being a — maybe malfunctioning — time machine?

I think this is consistent with the notion that the brain is an organ that’s future-oriented. As far as survival goes, the evolutionary value of the brain is to act in the present to ensure survival in the future, whether survival is figuring out a good place to get food, or doing an interview, I suppose.

And there’s something distinctly human about this? Animals have the ability to look into the future and plan, but not to the extent that humans do.

Yeah, so whether it’s the brain of mammals or other humans, the brain is always attempting to predict the future. If you’re a herbivore or you’re looking for a mate, your brain is telling you to go one way or the other because it’s making its best estimates as to what will optimize its chances of achieving that goal.

But what seems to be distinctly human is certainly the extent that we can engage in what we call mental time travel — this idea that we can consciously project ourselves back into the past and relive experiences. And it’s the ability to see the long-term future that I think is distinctly human. It’s impossible to overestimate how important that is, how much of your life is future-oriented, from going to school — from getting a job to saving for retirement to exercising and going to the doctor. These are all things that would be very difficult for other animals to engage in because they’re for the short- and long-term future. And one of the most transformative inventions humans have ever engaged in was agriculture. The notion of planting a seed and coming back a year later is something we take for granted now, but it’s hard to think of anything more important than that ability.

So much pop psychology these days prescribes mindfulness and being present, just attending to the here and now. After reading your book, that seems to almost go against human nature, against this capacity we have that has brought us so much.

I don’t think that thinking about the future or living in the present are inherently

good or bad, right or wrong. Obviously, most complex issues in life require finding the right balance. The current push a bit more toward living in the present and mindfulness is pushing back a bit against the fact that sometimes we do spend too much time worrying about the future.

I wrote about this interesting example of the Pirahã Indians, natives of the Amazon forest studied by Daniel Everett. They seem to have this very present-based existence. He argues that they don't think about the long-term future much. And my point there was that way of thinking attenuates much of the stresses we have in the Western world of anxiety produced by making sure we're economically stable, we're healthy, and our family is well taken care of, and so forth.

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But the problem is that everything we've achieved — the reason that over the past millennia humans have gone from having a life expectancy of 30, 40 years to 70 or 80 years — is precisely because we worried about those things. A present-based existence is good to one extent, but a healthy long life requires a significant amount of worrying about the future. So I think balance is what is sought after.

nymag.com/scienceofus/components/clay-paragraph/instances/cj1wepxiv00dovyyeemgoc08x@published" data-word-count="152">**We have such mastery over time compared to other creatures, but at the same time, time is still such a mystery in many ways. Compared to space, for example, which we feel we can directly perceive with our eyes, time seems invisible. You write about how we often resort to spatial metaphors to talk about time.**

Why are humans unique in our ability to grasp the concept of time for the short- and long-term? The argument is maybe humans are unique in this ability because they co-opted the circuits within the brain that allow us to understand space and applied those circuits in one way or another towards time. So obviously humans and other animals have these mental maps, spatial maps that allow you to, even with your eyes closed, navigate your room at night or find the bathroom. So you have this map in which space is mapped out within your mind.

And maybe the same idea applies to time, in which we can conceive of the past and the future by sort of traveling along these temporal maps within our brain. People have argued that's one of the reasons that the language of time often uses spatial metaphors. "In *hindsight* that was a very bad idea. I'm looking *forward* to meeting you next week. I see the deadline *approaching*."

Another way that humans have come to understand time is through physics

and philosophy. But, interestingly, that understanding of time conflicts with our lived experience of time and what neuroscience and psychology tell us about time.

In the context of physics and philosophy, to the extent that there is a favored or default view, it is that of the “block universe,” in which the past, present, and future are all equally real. So “now” is an arbitrary point in time as much as “here” is an arbitrary point in space. There’s absolutely no preferred moment in time. It’s just all equally real and equally valid. So this means that the past and the future are equally real as the present.

So once you’re in the block universe, we end up with this paradox, which is, it doesn’t seem that time would actually flow. Because if the past, present, and future all exist, this clear impression that we have of transience — of the transformation of the present evaporating into the past and creating the future as this active process — would not be real. The way that philosophers often put it is that time doesn’t flow. Time simply is. This is where the collision that you referred to comes in because, from a neuroscience and psychology perspective, certainly one of the most salient experiences we have is precisely of the flow of time of the past disappearing into the void and the future being wide open. So the clash is precisely that: Does time flow or not?

So what’s the resolution here? Who’s right?

I certainly don’t know the answer, to be clear. But I do think that in order to understand the nature of the universe we need to understand the nature of time. And to understand the nature of consciousness, we need to understand if our perception of the flow of time is a real property of the universe or something that’s sort of a creation or side effect of consciousness. So I think this is a fascinating and rare intersection of physics and neuroscience. I think time is this very deep problem, so deep, in fact, that it sort of forces us to work together to figure out if we want to accept our subjective experience of the flow of time as empirical fact about the universe, or not.

This is very deep stuff. Are there takeaways here that people can apply to their everyday life?

I think the short answer to that is, not that much. But to the extent that we understand why we behave in certain ways, why we make decisions in certain ways, why we perceive time in certain ways, I think those are positive steps toward understanding ourselves and making better decisions in our life. I discuss just a tiny bit, this issue of temporal myopia in that sometimes we don’t think enough about the future.

Yes, you talk about how humans, despite our capacity for planning, have a

strong tendency toward instant gratification. How does all this play out when it comes to taking action to address a long-term problem like climate change? It seems like we're not predisposed to handle that well.

Things like climate change seem to be perversely set up so that they're very hard to address both at the societal level and at the political level. It's hard for us to be as engaged in things that are cross-generational problems. Humans are uniquely able to think about the long-term future, right? But don't mistake that with the fact that we're particularly good at it. Compared to most animals, yeah, we're great. But that doesn't mean we don't have a long way to go.
