INTERVIEW

Interview with John Dupré and Liedewij Laan: Reflections on a World that is Movement all the Way Down

Myrthe den Boestert

As a philosophy student on the one hand, and a natural science student on the other, I often have to move. Quite literally: one study programme is in Leiden and the other in Delft, but the difference in topics, ideas, and methods also require a flexible academic position. Natural science and the humanities are often contrasted with. In my experience however, they are more alike than people think. Nanobiology led me to a view of the natural world as inherently "moving", which is a philosophical and metaphysical claim. I am not the only one that interprets science philosophically. In this interview, I sit down with philosopher of science John Dupré and Nanobiology professor and researcher Liedewij Laan, not to think about a specific movement, but, rather, to investigate what it means to think about the world in terms of movement.

John Dupré co-edited the 2018 book *Everything Flows: Towards a Processual Philosophy of Biology*, in which he examines the life sciences to conclude we should instead think the world around us in terms of processes. Taking after Ancient Greek philosopher Heraclitus' supposed famous statement *panta rhei* ('everything flows' or 'everything is in movement'), the world is characterized not by independent, rigid objects, but rather by fluidity and change: the world cannot exist without movement. This view of a world that is movement all the way down is recognized by Liedewij Laan, who draws the same conclusions from her research. But as a practitioner of natural science, Laan faces a different challenge than Dupré: translating philosophical abstract thinking into the every-day work of a researcher.

John Dupre is a Professor of Philosophy of Science at the University of Exeter in the UK and is part of the Santford School of philosophy of science. His interests include metaphysics of biology, alternatives to determinism and reductionism, and general philosophy of science. The process ontology set out in *Everything Flows* finds its follow-up in *Everyone Flows* (2025), Dupré's most recent book. Here he expands his ideas to fundamental questions concerning topics like human freedom and personal identity. His work on Darwinism has earned him in 2010 the election of Fellow of the American Association for the Advancement of Science. He has been president of several societies and associations related to philosophy and was elected a member of the American Philosophical Society in 2023.

John, if I understand it correctly, in Everything Flows you talk about two contrasting world views: one that focuses its perception on objects and one that focuses its perception on processes and the flow of things. Could you explain a bit more about what you call a substance ontology and a process ontology?

"I generally like to begin with the Presocratics: already at that time you had a camp that says 'everything changes'—Heraclitus—and 'nothing changes'—Parmenides. I argue that most people follow Parmenides: for example our view of atomism reflects his philosophy. Atomism suggests that while atoms may change their relations to each other, they are themselves unchanging objects. The appearance of change is then just the consequence of different relative positions. That view has worked quite well for the physical sciences over a long period, but it works less well for the life sciences, where movement and change are explicitly abundant. An example from my book is that an animal, which we usually think of as an object with a fixed set of properties, has a whole lifecycle. While we tend to see the adult stage as the true representation of the animal, we should not forget that it isn't any less of an organism in the other parts of the life cycle. Actually, it is the lifecycle itself that constitutes the organism: the animal needs all the stages to exist. On a smaller scale, metabolism is a great example: material constituents are continuously exchanged, and only because of this movement can the organism exist.

Process ontology is the opposite of the more traditional substance view: what we think of as stable things are in actuality

temporarily stabilized bits of process. An example is an eddy in a river. Eddies are reversed currents that appear behind large stones. It seems like a stable pattern, but the stability is a consequence of the dynamics of the river. The actual water that makes up the eddy is also constantly changing, just like organisms and their parts. Life is a complex set of flows, and you and I are eddies in that flow."

In current times, we see a rise in popularity of political parties that seem to view movement and a flowing world as dangerous. Do you think processual thinking can help to give us language to understand those topics differently?

"I would love that to be the case. On the 16th of April (2025) the Supreme Court in the UK gave a ruling that man and woman refer to biological categories[1]. I don't disagree with the argument that biological categories have significance, but the idea that people take from that is: "We found out what things are, what kind of things they are, and what essential property they possess." The essential property, then, should pretty much determine a set of related properties throughout the life history. But when you think in processual terms, you don't have to pin things down that way. You can think that there are these different starting points that many humans have one or another of. These starting points in a social context tend to produce a lot of characteristic outcomes for people in these categories, but the diversity of these processes is enormous. Categories such as biological sex are very limited in telling us where people end up. So yes, a fluid view of human life as opposed to an essentialist view helps: it assumes movement is a norm instead of something to act against."

Substance ontology is more widespread than process ontology. You already mentioned the philosophical and scientific history behind this, but do you think there is something from a socio-political standpoint that makes substance ontology more attractive to people?

[1] For Women v The Scottish Ministers. 16 April 2025. Supreme Court

"This is very speculative, but one thing that is often said is that people tend to look for certainty, security, and predictability. It is true that we live in a chaotic and dangerous world, so it seems logical that people would like to say 'this is how it is' and 'if we understand it fully we can manage it fully' and so on. Foregrounding movement is threatening to that line of thinking: suddenly things change, there is novelty and difference. To overcome that fear, one must make people's lives safer, but that is a big task.

"Don't look for a stable world. Accept that the world is moving, and try to make it better."

Another part of the solution is more education: we need to encourage people to be more open-minded, to learn about different ways of being. That is exactly the opposite of the current response now, especially by right-wing politicians. I certainly do not always think that things get better when understood as a process, but I would say: don't look for a stable world. Accept that the world is moving, and try to make it better."

Usually, we talk about movement as if an object undergoes a positional change. But in a process ontology you don't have that 'object' in the first place. How would you reconceptualize movement in process ontology?

"As a process philosopher, the first thing you do is look at the things—or in philosophical terms, substances— that we used to think made up the world. In the process view, such things are stable structures that must be actively maintained by processes. You see this everywhere in biology: much of what organisms do, such as a bacterium following a chemical trail to food, is needed to continue living. They need to move to stabilize themselves, and when they are stable, they can again act and interact with other things, much of which in turn is required to maintain their stability."

If change is the norm, then stasis becomes interesting. In the book stasis is described as needing activity to become and to be, but it

might also be conceived as being in a dichotomy with movement. How do stasis and movement relate to each other in the process ontology?

"They are certainly not in opposition; there is no dichotomy because there is only change. Out of these processual movements emerge stabilized structures. Think again of the eddy. Eddies are not stable structures in the sense that they just sit there, like a piece of machinery you put in your attic—although even there I would say there are atomic or subatomic processes that maintain the machinery. The stable things I am interested in are only stable because they work so hard to be stable, on so many levels. For example, finding food to eat: an animal needs to move around the world to find all the resources to maintain itself as a stable structure. And that structure is constantly maintained by trillions of metabolic events. So, it really is the eddy situation, but vastly more complex."

Some of the processes are random, but in some cases a process moves towards something. What is the role of purpose in your ontology?

"For living systems, if a system does not have the tendency to do the activities that keep it stable, it would not even exist. At the beginning of life, you have only organisms that have a tendency towards certain things: we can hardly speak of purpose there. But as animals get more complex and develop more adaptable ways of dealing with changing environments, it becomes more natural to talk about agents that make decisions. In my new book *Everyone Flows* I try to talk a bit more about the difference between free choice and a preconditioned response to a predetermined set of conditions. With humans, it is clear we have all kinds of acts beyond just surviving and reproducing. The ability to do this is fundamentally dependent on making choices. We constantly achieve stuff as humans. Who accomplishes these achievements, though, becomes vague: the boundary between the social and the individual fades once you get to the point of organizing your world around long-term goals. Part of the evolution of stability is the evolution of ways of

creating stabilities that transcend what is implicit in the ability to survive."

* * *

Liedewij, can you explain briefly what you do as a researcher, to give a bit of an introduction to the humanity scholars?

"I am a physicist particularly interested in the physics of life, with a focus on the remarkable resilience and adaptability of living systems. I study how these properties arise from molecular interactions. We do experiments and theoretical work to see how cells and proteins behave. We also try to mimic these processes with computer simulations to understand on a more abstract level what is going on. And then we think about all these topics through philosophy!"

I have already spoken to John Dupré, whose work you introduced me to. He proposes a process ontology, that contrasts with the dominant substance ontology and views the world as fluidic instead of rigid. What is the relation between these philosophical views and your background as a scientist?

"When I studied physics, I had never thought about this kind of philosophy, and there was also no discussion on the topic. But when I started coming into biology, especially biology on the nanoscale, I realized everything is dynamic and nothing is static. The world of small-scale objects is full of little dances. However, in textbooks of biology, objects are portrayed as rather solid-like and people also talk about biology in this kind of static way. Through my research I realized that this view does not match reality. Instead, the idea that reality is determined by moving processes, became more

"The world of small-scale objects is full of little dances"

Liedewij Laan is an Associate Professor at the Technical University of Delft. Since 2014 she has been the Principal Investigator of an independent research group (https://laanlab.tudelft.nl/). With a PhD in experimental biophysics, her work focuses primarily on understanding the networks and processes of small-scale living systems such as yeast. In addition to this, she is also part of the national EVOLF program (2024) that aims to recreate the fundamental functionalities of life bottom-up. Laan is a member of the Dutch Physics council, a vocal ambassador for Women in Science, and set up the national initiative Beta in Bestuur Beleid (BiBB) to bridge the gap between science and politics.

and more prominent in my thinking. And when you realize you should think differently, you will end up in philosophy."

Can you give an example of how your research points to movement as fundamental?

"Some time ago, we were studying the prevalence of specific proteins across species, and when we compared species, we could not always find certain molecules. At that time, I was still asking myself the wrong questions. I was wondering 'How is it possible that those proteins got lost during evolution? They should not get lost.' We ran conceptual simulations and from that we figured out it is actually very easy to lose proteins during evolution; the real question is to keep them where they are. And that is because ultimately, things will move. You cannot stop that. It is the same in the systems we see around us: at university, people leave to get jobs, and new people come in. To make something stay, you have to put a lot of constraints. But for some reason, we have the notion that it is the opposite: that it takes energy to change something."

Given this processual view, you approach your research differently. For example, instead of studying single molecules, you study processes. How do you set up your research in a way that does justice to that view? And which challenges does this introduce for you as a researcher?

"The biggest challenge is that the tools we have so far are not designed with a processual view in mind. In substance ontology, you

might want to label an individual object. That we can already do. But a process can continue to exist even when its specific objects change over time, so this old way of working is not useful anymore in that case. In my lab, we try to set up research tools, for example with computer simulations that allow you to look at collectives that have properties that are not specific to the single elements. There are also experimental techniques that make proteins label other proteins when they encounter them, so they are marked in a detectable way. It is a bit like Google Maps, which is a map that is fluidic: it is different every day. You can see where it is busy at a certain time, and you use that knowledge to change your movement. We try the same thing with the proteins labelling each other; then you see something is going on, because there is a lot of movement. It is like a traffic jam. With this method, you do not have to focus on selecting a specific protein beforehand. You do not even have to know what molecules are in the process; everything that moves in certain space during a certain time period becomes visible. As a researcher, you do not always know what you're following, so as the process goes on, you follow different players.

No one doubts that Google Maps should be a fluid map, because we assume a moving world behind it. A processual view takes movement as a fundamental thing that is not something to be scared about: the method cannot be static."

And what does that do for the certainty of your data? Often, science is expected to yield very certain answers, but in this case your method is not tied down to a static thing.

"If you accept a different philosophical ontology about life than is the norm in the field —which is a challenge, but an important step to take— it automatically means you ask different questions. If you hold on to questions like 'Which specific molecules are involved?' then you are horrified by this different approach. It will not give you an answer to that question because it focuses on other information. This approach lets the process determine the objects of interests, and the process is always different. Even if it is less specific on certain questions, it is still precise in its own domain; but about new aspects of the problem."

Most data in science appears set in stone: you get a number that represents something, and you have to pin down your results to be able to work with it. How do you reconcile this with doing justice to the moving world the data represents?

"Data may seem rigid, but it always exists in a context. A researcher should therefore think dynamically about data because the interpretation changes depending on context. In the process of doing science, the numbers may seem like fixed 'rocks', but you have to move around them and play with them in your head. Also, there is often data that does not directly fit. To make sense of this, you also have to move positions: standing still does not work. The data gives some constraints, but this does not mean the position and the role of the object do not change over time.

In the end you can say 'everything is static' or 'everything is flowing' depending on the time scale you look at it. If you look at very small timesteps, then everything is static, because you look very shortly. But if you look very long, everything is dynamic. Some parts are more static than others, and some parts are more fluidic. But in biology, almost nothing is always static. In the end everything moves, but just at different speeds."

The papers in this journal are all work on movement by the humanities and social sciences. Often some split is made between them and the natural sciences, in which the latter is often seen as more certain or less flexible. How do you feel about this?

"I think that is a misconception that natural science studies things that are very deterministic and rigid. But we are not so different from the humanities, we all study complex systems. It is just that our objects are a bit more controllable. You can't do that with human culture. In nanobiology, we can at least paralyse things temporarily to look at them. But that shouldn't lead to the assumption that things do not move in natural science. In the end, we all live in the same world: and that is one of movement."

Bibliography

For Women Scotland Ltd (Appellant) v The Scottish Ministers (Respondent)". (2025). Supreme Court, case UKSC 16. Available at: https://supremecourt.uk/cases/press-summary/uksc-2024-0042 (Accessed: 14 May 2025).

Further reading

Dupré, John. *Everyone Flows: A Process Philosophy of Human Life*. Oxford University Press eBooks, 2025. doi:10.1093/9780198941866.001.0001.

Nicholson, Daniel J., and John A. Dupré (editors). *Everything Flows: Towards a Processual Philosophy of Biology*. Oxford University Press eBooks, 2018. doi:10.1093/oso/9780198779636.001.0001.

Kingma, Enzo, and Liedewij Laan. "Global Genetic Rewiring During Compensatory Evolution in the Yeast Polarity Network." *bioRxiv (Cold Spring Harbor Laboratory)* (February 18, 2024). doi:10.1101/2024.02.15.580535. (preprint)

Linne, Christine, Eva Heemskerk, Jos W. Zwanikken, Daniela J. Kraft, and Liedewij Laan. "Optimality and Cooperativity in Superselective Surface Binding by Multivalent DNA Nanostars." *Soft Matter* 20 (January 1 2024): 8515-8523. doi:10.1039/d4sm00704b.