Q&A: Philosophy meets physics—professor uncovers hidden truth about Newton's 300-year old law

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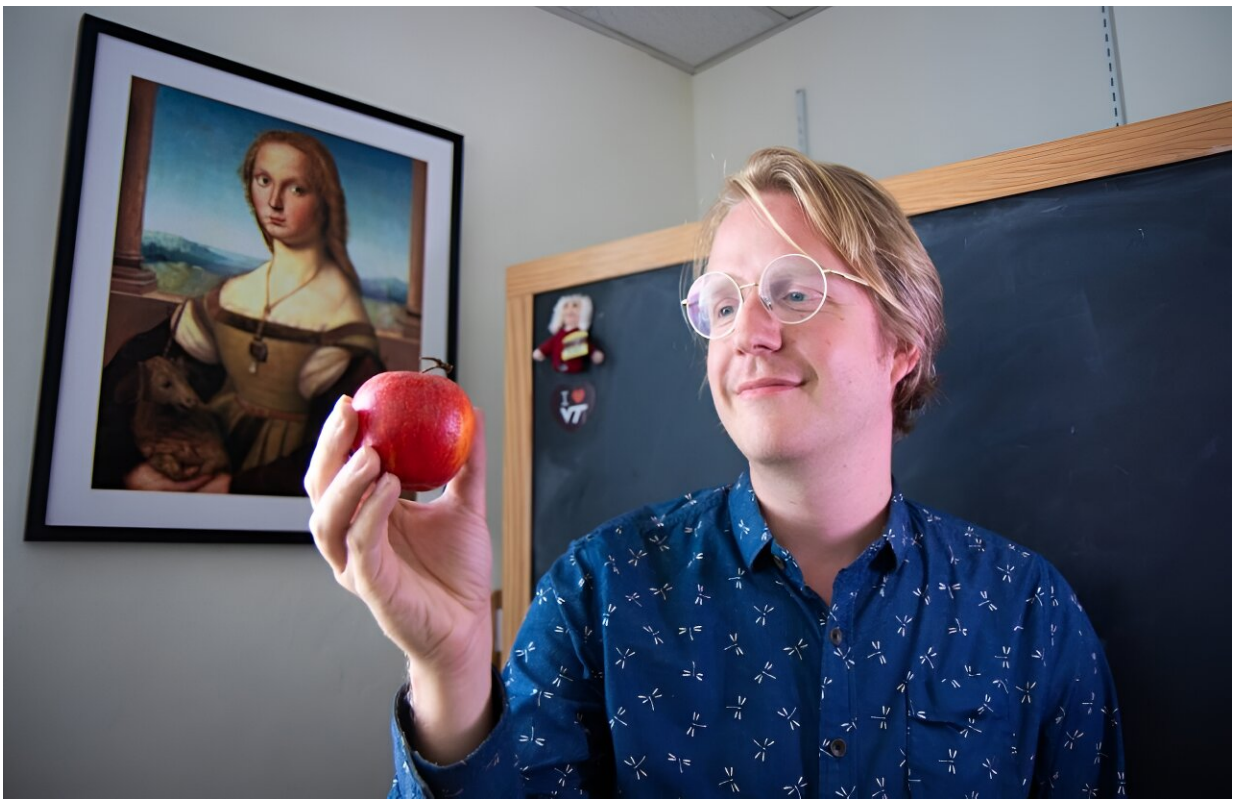

"The way I was taught Newton's first law in physics class in school never really made sense to me. And actually, that turns out to be true of a lot of people," said Dan Hoek, assistant professor in the Department of Philosophy. Credit: Andrew Adkins for Virginia Tech

Like most high schoolers in an intro to physics class, Dan Hoek heard the legendary tale of Isaac Newton and the apple.

Here's how the story goes.

While resting beneath a tree, Newton watched an apple shake from a branch and fall to the ground. He had an epiphany: Could the force pulling the apple from the tree be the same as the force keeping the moon in orbit?

Newton published his laws of motion in 1687. Written in Latin, the first law is typically translated as "a body at rest remains at rest, and a body in motion remains in motion, at constant speed and in a straight line, unless acted on by an external force."

Hoek had been perplexed by the law's wording ever since his high school days in the Netherlands. The law seems to make an exception for bodies that are subject to external forces.

Here's the problem. All objects are subject to external forces. Everything in the universe is constantly being pushed, pulled, kicked, or acted on by other objects thanks to gravity. Scientists and other theorists have long puzzled over this point, but never reached a conclusion that satisfied Hoek.

Flash forward to 2021.

Now a philosopher at Virginia Tech, Hoek's curiosity about Newton's law has only grown stronger.

Blending his love of both philosophy and physics, Hoek pored over the different translations of Newton's work. Then came a breakthrough discovery: Newton's first law has been misinterpreted for the last 336

years.

This fall, Hoek published his findings. The original Latin wording of the law states that a body at rest remains at rest, and a body in motion remains in motion, at constant speed and in a straight line, except insofar as it is acted on by external forces—not "unless acted on."

Now, this detail "may seem like a little hairsplitting thing," said Hoek. "But it actually makes a huge difference, because this law applies to objects in the real world."

Since announcing his finding, Hoek has spoken with educators and media outlets around the world, including an interview with *Scientific American.*

From his office in Major Williams Hall, Hoek answered four questions about his passion for philosophy, physics, and Sir Isaac Newton.

Many people might not expect a philosopher to play such a pivotal role in reinterpreting Newton's first law. What was the motivation behind your decision to delve into the study of this foundational scientific concept from a philosophical perspective?

People often think that philosophy has nothing to do with science, but actually, philosophy and science have everything to do with each other. In fact, for most of its history, science just was philosophy. Isaac Newton was a philosopher. He called himself a natural philosopher.

I have been interested in physics ever since I was a kid. And perhaps the only reason why I ended up pursuing philosophy rather than physics was that I'm also very interested in other things, such as language, mathematics, and all sorts of mysteries of the mind. And what really excites me most are questions that connect the dots between these

different areas.

In a nutshell, can you explain how your reinterpretation of Newton's first law changes our understanding of classical mechanics and why is this reinterpretation important for the field of physics?

The way I was taught Newton's first law in physics class in school never really made sense to me. And actually, that turns out to be true of a lot of people. Since my discovery broke, I get emails every day from physics teachers, high school students, and university students who are all puzzled about the exact same thing I've been puzzled about for a very long time.

My reinterpretation of Newton's law impacts all real-world objects. One example—and this is Newton's own example from his book "Principia"—is the spinning top. Newton says a top just keeps on spinning and spinning and spinning except insofar as resistance forces prevent it from doing so. And if you think of a rolling apple, it will keep on rolling except insofar as forces prevent it from doing so. Newton's point was that objects, which are constantly being pulled and pushed, only diverge from their motions to the extent that these external forces make them.

How does your reinterpretation of Newton's first law bridge the gap between the sciences and the humanities?

In philosophy, you're encouraged to stay curious about a number of things. This is a great example of how philosophy helps make connections between different areas. To put this discovery together, I

needed to know a little bit about physics, but I also needed to know a little bit about language and logic, and about the history of science.

I had to ask myself why people thought about Newton's first law in the wrong way in the first place. And how did this misinterpretation connect to the physics puzzle about the first law? Physicists have always understood the physics piece to this puzzle, but they did not have the history and language pieces.

It can be easy to confuse the truth with the story people have been telling for a long time. In this case, everyone was primed to read Newton's Law as saying what they had been taught it had to say. Philosophers are trained to question things and to read texts very carefully, which can help us get back to the truth. It can take an idea from one place and use it to cast light on something else in a completely unexpected way. That's one way philosophy can help science, and demonstrates how we can make connections between science and the humanities.

In what ways does the philosophy discipline continue to play a vital role in a technology-driven world?

For me, philosophy is still everywhere. You can use it to take an idea from one place and cast light on something else completely unexpected. Philosophy encourages you to stay curious about everything.

When philosophy first emerged thousands of years ago, anyone who wondered how things worked in the world was a philosopher. Over the centuries, bits of philosophy split up into different disciplines. Newton was an extremely important figure in the splitting of physics from philosophy.

The role philosophy plays today is to hold onto all of the leftovers. If you

think about a university as a house where each department has its own room and its own set of distinctive questions to answer, then philosophy is like the messy attic. It's the place where all the questions end up going that don't fit in any of the other rooms. Of course, the attic is a great place to spend some time. You have a chance to make progress on answers to all of these interesting questions that don't quite fit in the rest of the house. And making progress on these questions requires making connections between different disciplines and topics. If you're interested in doing that sort of thing, then philosophy is the place for you.

Provided by Virginia Tech

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