

From quarks to quails: Can the different sciences be unified?

January 28 2020, by Vanessa Seifert



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The world around us is populated by a vast variety of things—ranging from genes and animals to atoms, particles and fields. While these can all be described by the natural sciences, it seems some can only be

understood in terms of biology while others can only be explored using chemistry or physics. And when it comes to human behavior, disciplines like sociology or psychology are the most useful.

This richness has intrigued philosophers, leading them to think about how the sciences are connected (or disconnected), but also about how things in the world relate to one another. Our new project, called the [Metaphysical Unity of Science](#) and funded by the European Research Council, is trying to answer these questions.

In general, philosophy distinguishes between two main questions in this area. First, there is the [epistemological](#) question of how specific sciences or theories are connected to one another. For example, how is biology related to physics or psychology to biology? This focuses on the state of our knowledge about the world. It involves looking at the concepts, explanations and methodologies of the various sciences or theories, and examining how they are related.

But there is also a metaphysical question of how things in the world are related to each other. Are they over and above the stuff that is postulated by fundamental physics? That is, are molecules, chairs, genes and dolphins just complex aggregates of subatomic particles and their fundamental physical interactions? If so, is living matter in any way different from inanimate matter?

This is a very difficult question to answer, not least because of the existential weight it carries. If humans, among other things, are just sums of physical parts, then we might wonder how we can make meaningful sense of consciousness, emotions and free will.

Extreme views

We could broadly map the existing philosophical positions within two

extremes. On the one side, there is the [reductionist stance](#) which in one form claims that everything is made of and determined by physical building blocks—there are no chairs, dolphins, economic inflation or genes, only particles and fields. This implies that sciences like chemistry and biology are just helpful tools to understand and manipulate the world around us.

In principle, the "correct" physics would explain everything that happens and exists in the world. It could therefore be, or help build, the basis for a unified theory. On this view, even something as complex as consciousness, which [science](#) may not (yet) properly explain, is ultimately down to the physical behavior of the particles that make up the neurons in the brain.



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On the other side, there is the [pluralist stance](#) which argues that everything in the world has an autonomous existence that we can't eliminate. While there might be a sense in which chemical, biological or economic entities are governed by physical laws, these entities are not mere aggregations of physical stuff. Rather, they exist in some sense over and above the physical.

This implies that the special sciences are not just tools that serve specific goals, but are accurate and true descriptions that identify real features of the world. Many pluralists are therefore [sceptical about](#) whether consciousness can ever be explained by physics—suspecting that it may in fact be more than the sum of its physical parts.

There is evidence to support both reductionism and pluralism, but there are also objections against both. While many philosophers currently work on addressing these objections, others focus on finding new ways to answer these questions.

This is where the ["unity of science"](#) comes in. The notion originates from the reductionist side, arguing the sciences are unified. But some forms of unity reject reductionism and the strict hierarchies it invokes between the sciences, but nevertheless adhere to the broad thesis that the sciences are somehow [interconnected or dependent on each other](#).

Our team, consisting of philosophers with an expertise in different areas of philosophy and science, is trying to find new ways to think about the unity of science. We want to identify the appropriate criteria that would suffice to convincingly claim that some form of unity holds between the [natural sciences](#). We are also looking at case studies in order to

investigate "neighboring" sciences and how they depend on each other.

The outcomes of our project could have important implications that go beyond academic curiosity, ultimately helping science to progress. If there was indeed a way to describe how life is related to elementary particles, that would change the game completely.

So far, the project has conducted a number of [case studies](#) at the boundaries between biology and chemistry, and chemistry and physics. We are now starting to apply the results from these cases to the metaphysical framework for the unity of science. For example, one of our studies showed that many biological properties of proteins [can be explained](#) in terms of their chemical micro structure, rather than their environment. This doesn't prove that reductionism is true, but it does lend support to the view.

Another study investigated similar issues from the perspective of chemistry and [quantum mechanics](#). Both theories assume that an isolated molecule [has structure and is stable](#), but the study argued that you cannot prove this is definitely the case—we describe this as an idealization. It showed that both chemistry and quantum mechanics rely on making such idealizations and argued that identifying them can improve our metaphysical understanding of molecules.

Ultimately, understanding the interconnections of the natural sciences is a valuable source for understanding not only the world around us, but also ourselves. We are hoping that our investigation of these links can illuminate in new ways how things in the world relate to each other.

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