

Abstract:

This paper looks at the expression of physical realities in terms of mathematics as the problematic relationship as it has been regarded throughout and attempts to offer an explanation.

Darwin and his Chicken: Is the effectiveness of mathematics in physics really that confounding?

The one thing that natural sciences and social sciences, both we may add mere human disciplines, agree on is that the human mind has a tendency to draw predictable patterns based on its observation of reality, in whatever form, and understand it. In social sciences, stereotypes and prejudices are seen as a result of this tendency; the assumptions made based on our experiences of various types of people. The natural sciences would, for instance, look at the turbulent flow of water which may seem random but is able to find an underlying pattern to its flow. Both in their own way attempt to explain physical and social observations of reality using patterns.

Apart from this, the human mind also tends to simplify and classify whatever incoming information it may perceive. In the same examples, while stereotyping helps simplify our perceptions using classification, the seemingly random flow of water starts making sense and makes our understanding of the world more lucid. The difference however stands out vividly: while one is culturally defined, the other is physically defined, and hence while one is relative to a person's sociocultural milieu, the other, i.e. the physical science is universal.

Physics as discipline uses mathematics more or less like thought uses language, i.e. as an efficient mode of expression. In this analogy, a question is raised. Which influences which, and to what extent? In the case of language and thought, one might argue for both sides. Thought obviously influences language, as language is a mere expression of thought, but conversely, language could also influence thought in that thought is constructed of language itself. Let's appropriate this to the relationship between physics and maths; physical realities obviously created the necessity for mathematical formalism, as a result of which mathematics as mode of expression arose simply as an analogy to physical observation, much as language gives voice to thought. But, on the other hand, it cannot be ignored that our knowledge of our physical reality is constructed of mathematical formulae and theorems. This sounds like the popular chicken and egg conundrum.

Coming back to our desperate attempts at deriving predictable patterns and symmetries in our observed and lived reality, mathematics becomes our sole point of departure. Mathematics fulfils this purpose by being exactly what we need; predictable, made up of patterns and symmetries, and above all, simple. We construct our knowledge of physics in terms of mathematics, which makes physics seemingly deterministic, because we are able to predict the behaviour of a system of particles in the future and also its state in the past based on our observation of the present and also to subsequently discover previously unknown phenomena. It is unapologetically convenient, and perhaps this has raised eyebrows on the "unreasonable" effectiveness of mathematics in the discipline of physics.

In our opinion, the function of mathematics in the realm of physical sciences is not at all unreasonable, in fact it is meant to be as effective as it is. Mathematics, like any language or mode of expression, is a construct of the human mind, and it more or less follows the rules we make, allows

of the assumptions we need, and works according to our convenience in our endeavour to make sense of our observed reality. One may ask then, why mathematics and not any other form of representation. The answer lies in the analogy drawn previously. If we were to adopt a system of signs, such as a language, we would put our understanding of universal reality at the mercy of cultural factors. Language is a human, and more so a cultural construct, but physics looks at a reality that is constant not only across cultures but across the space-time continuum itself. We must therefore adopt a universal system of signs and expression, which mathematics provides us.

In saying this, we do not reject the possibility of there being or having been another system(s) that could work to represent our observations, but in our very Darwinist belief mathematics prevails because any other system proved ineffective to do its job, and therefore got filtered out. We also believe, in that very Darwinist fashion, that the form of mathematics in use currently is not its best version, because it is unable to consider ALL physical phenomena, known and unknown. We look forward to an even further evolved form of mathematics that is able to attend to our theoretical crises.

Hypothetically, if we were to encounter a physical problem that is inconsistent with our current tool of mathematics, in our belief it could be because of some cracks in the course of its consolidation. It goes without saying that we as humans are not perfect beings, and have constructed the tool of mathematics based on our needs, which makes it possible that we have neglected certain aspects of mathematics which may not have been significant at the point of its conception. An example of this neglect would be in the form of the assumptions made for the sake of convenience that may at some point in the future be proved wrong. Innocent until proven guilty! However, since we have already built a great understanding of our reality based on these assumptions, we may not observe these cracks growing. The danger lies in the fact that this growth can only be perceived in retrospect.

In conclusion, we come back to the chicken and egg conundrum, and assert that the question of which came first, physics or mathematics is irrelevant, because in the general scheme of things they have the same implication. Physics implies mathematics and mathematics implies physics. The same may not be said of language and thought, which is where we break our analogy. The end of all disciplines is to explain the universe as we observe and perceive it, and in this endeavour we choose whatever tool we find most effective and convenient. In the case of physics, mathematics is that tool, and one which we have consciously chosen for the job. Therefore any doubt upon its "unreasonable" effectiveness is, in our opinion, obsolete.