The Hard Problem of Sensation

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1. Awareness via mathematical realism

Mathematical realism (also called Platonism) provides a framework for understanding how consciousness can arise in physical beings, but the realm of sensation presents further puzzles. So from this standpoint, the hard problem adheres to sensation rather than to consciousness itself.

Let me explain. Mathematical realism is the doctrine that the structures studied in mathematics, the numbers, geometries, the endless varieties of sets (manifolds, topologies, Hilbert spaces,...) have an existence independent of our minds. When we

do mathematics, we are discovering things about these real mathematical objects, not inventing them. Realism is perhaps a minority position in the philosophy of mathematics, but is the common attitude from which mathematicians practice their trade. At the end of this section, I briefly describe a less extensive form of realism that supports the same conclusions

Structures that can be modeled by mathematical objects are found throughout our world. Such structures include not only space, fields (such as gravitation and the electro-magnetic field) and counts of things (numbers), but any structure whose workings can be described precisely, such as the game of chess, or a computer program in any language.

Now, when I am aware of space, it feels from within that I am aware of something with three orthogonal directions, in which objects can be moved along paths, and rotated, and in which objects have extension. Call this phenomenal space. Mathematicians have discovered the structure R^3 exhibiting these properties. There are differences. Most notably, phenomenal space and its contents are (presumably) finite structures at any given moment. Positions in R^3, on the other hand, are given with infinite precision. Also, positions in phenomenal space are usually given relative to the host of the space in question rather than a fixed coordinate system.

But still, phenomenal space can be viewed as a mathematical structure. Like R^3, it is a container for shapes, which can be described by other mathematical structures such as those used in 3D CGI (computer-generated-imagery), structures which in turn have their own phenomenal counterparts. The exact forms of phenomenal space and its phenomenal contents have not been worked out, although phenomenologists, notably Husserl and Merleau-Ponty, have made a start. Husserl has a nice treatment of the finiteness of the contents of each moment of spatial perception within an infinite manifold, via his idea of "horizons". Each perception of an object comes with a horizon of possible extensions, which consist of possible new views, perhaps closer

views, of the object. Thereby, objects are presented to awareness as endless in content (infinite), even though finitely presented at each moment.

In any case, I find it plausible that our awareness of space *is* a mathematical structure, a structure whose existence in our minds follows from mathematical realism.

How is this awareness constructed? By emergence.

By emergence of a mathematical structure B from structure A, I mean that B's primitives and relationships can be defined directly, or alternatively in the terms provided by A. An example is provided by the way that Euclidean geometry (B) emerges from the real numbers (A) via cartesian coordinates. Instead of positing points and lines as primitives, and writing down, as Euclid did, the laws that govern them, a point can be defined as a pair or triple of real numbers, and a line by a point and direction.

Note that I have defined emergence in a simple way. The term has been applied to a wide variety of things.

This sort of thing happens often among mathematical systems which describe the physical world. For example, classical thermodynamics emerges from statistical mechanics. An example of a tower of emergence: chemistry emerges from quantum field theory, biology from chemistry, and neurology from biology. Each has its own level of description via its own set of mathematical objects.

Another tower starts with quantum field theory, but follows with the physics of semiconductors, theory of circuits, programming at the machine level, then at the level of the various high level programming languages. A software application might have its own mathematics, such as CGI where shapes and motions are modeled.

Now, according to mathematical realism, each level of emergence *exists* . A circuit level description of the operation of a computer is just as real as its quantum field description. And the geometric description of shapes modeled in a CGI application are as real as the circuit level description of the computer in which the CGI is running. Similarly, the modeling of space and shapes of objects in our brains, regarded geometrically, is just as real as any description at the neurological level. The differences between brain and computer are extensive — for one thing we know exactly what goes on in a computer, but only have foggy ideas about how space is modeled by neurons. Perhaps computer vision systems based on deep learning will provide a clue. In these systems spatial descriptions are encoded by synaptic weights. This can only be a clue, not an explanation, since natural neurons are far more complex than their artificial counterparts.

Emergence in both of the towers mentioned above comes in layers. Each layer is a causal system which can be described independently of the layers below it, if the range of states of the lower layers are appropriately constrained. This at least is true of the computational tower, where we have full understanding of what is going on. The situation is murkier on the biological side, since many details are unknown.

My speculation is that consciousness constitutes one of the layers in the biological tower, and that phenomenal space is a mathematical structure within that layer.

This is a sketch of how our awareness of space and its contents might arise in our brains: a mathematical description of space and its contents might really exist there, at a level of emergence well above neurons, where it constitutes our spatial awareness. Space is present *to* us because it is present *within* us.

What applies to space, applies to other mathematical structures with phenomenal variants: the game of chess and computer programs, for example. Also, phenomena

such as planning, self-knowledge, and memory can and have been cast in mathematical terms. The speculation is that these structures live along with phenomenal space in the same layer of emergence.

My conclusion*: there is no hard problem of consciousness in the general case. That is, consciousness of some things, such as space, does not present a hard problem in Chalmer's sense.*

A weaker, and perhaps more plausible, form of mathematical realism yields existence of the kinds of structures that I have been discussing. Namely, we need not say that *every* mathematical structure exists, but only those causal emergent structures whose chain of emergence is grounded in mathematical physics.

2. Sensation

However, this stance does not apply to other realms of consciousness. In these realms, the hard problem persists with full force. The case that I'll discuss is that of an atomic sensation. Such sensations are known as qualia in the philosophy of mind, and examples include colors, smells, and pains. Husserl called them hýle.

Here, it is adequate to consider the example of colors.

This is how the matter seems to me. Each color has its own essential nature, and that nature is disclosed to me in its exactness at the moment that I see it. Of course I am referring to the experience of a color, not some external thing such as a wavelength. I cannot recover the exactness of a color experience in memory, only the general category (linked to its name). But when a color is before me I cannot but think that I "know" exactly what I am seeing. Of course, colors are almost always encountered as properties of objects, but I have no problem in mentally isolating the color experience.

So colors are definite essences that appear within experience. Different colors are different essences.

These convictions are not based on deduction, but arise from direct experience. Unlike the eliminativists, I cannot manage to doubt them.

My brain is built to believe these things, it seems. I cannot do otherwise, nor can I specify scientific meanings for the beliefs.

How can we account the fact that colors arise in the form that they do from a neural substrate? Why should 700 nanometer radiation, when processed by cones in the retina, and neurons of the occipital lobe, generate the sensation (red) that it does, and not blue instead? Why should it generate any sensation at all?

This seems an entirely intractable problem, which by its nature falls beyond scientific and mathematical thought. It is not even possible to formulate in scientific language what a color phenomenon *is*. Philosophers have not provided, as far as I can tell, any hints of an answer either. Most agree about its current intractability.

The image at the top of this note illustrates my points. It displays a moderately complex spatial structure, rendered in cyan. We see mathematical properties in the structure — symmetries and the like. The color cyan, however, does not appear to us as a structure at all, certainly not a mathematical one. It is an essence whose nature is a central mystery of our world.

Consciousness

Mathematical Realism

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