

Mental Causation

The Problem of Mental Causation is a major problem in the Philosophy of Mind. It has been with us at least since RENÉ DESCARTES claimed that mind and body are separate substances. If the body is only physical and material, how can a non-physical and immaterial mind possibly act on the body. More importantly, how can a “mental” action or event in the mind be the cause of a physical action by the body?

Mental causation is a specific case of the more general problem of downward causation, for example the downward control of the motions of a cell’s atoms and molecules by supervening biological macromolecules. Is the molecular biology of a cell reducible to the laws governing the motions of its component molecules, or are there emergent laws governing motions at the cellular level, the organ level, the organism level, and so on up to the mental level?

Can emergent properties or laws at the higher levels of a physical-chemical-based biological system prevent those higher levels from being reduced to the properties and laws of the base physical level?¹ See chapter 26 for more on emergence.

In the 1960’s the neuroscientist ROGER SPERRY claimed that higher levels in a hierarchy could act causally on the base level. He cited a wheel rolling downhill as an example of what he called “downward causal control.” The atoms and molecules are caught up and overpowered by the higher properties of the whole. Sperry compared the rolling wheel to an ongoing brain process or a progressing train of thought in which the overall properties of the brain process, as a coherent organizational entity, determine the timing and spacing of the firing patterns within its neural infrastructure. A few years later (1974), DONALD CAMPBELL coined the phrase “downward causation.”

The locus classicus of recent discussions of mental causation is DONALD DAVIDSON’s 1970 essay “Mental Events,” which was revisited in his 1993 essay, “Thinking Causes,” published together with 15 critical essays on Davidson’s work in the 1993 book *Men-*

1 See chapter 26 for more on emergence.



tal Causation, edited by JOHN HEIL and ALFRED MELE.

Davidson claimed three things:

- That mental events are causally related to physical events
- That causal relations are normally governed by strict (deterministic) laws
- But that there are no such strict laws for mental events acting on physical events

Davidson's goal is to deny the reducibility of mental events to physical events in the lower levels, especially to deny the physicist's reductionist claim that the motions of the atoms and molecules at the lowest level are causally determinative of everything that happens at all higher levels.

Information is neither matter nor energy. It is sometimes embodied in matter and sometimes communicated as pure energy. It is the scientific basis for an *immaterial*, yet causally efficacious, mind that can control the body and affect the physical world. Information is the modern spirit.

But prominent philosopher of mind JAEGWON KIM says that Davidson's goal of "non-reductive physicalism" is simply not possible. The physical world is "causally closed," says Kim:

"what options are there if we set aside the physicalist picture? Leaving physicalism behind is to abandon ontological physicalism, the view that bits of matter and their aggregates in space-time exhaust the contents of the world. This means that one would be embracing an ontology that posits entities other than material substances — that is, immaterial minds, or souls, outside physical space, with immaterial, nonphysical properties."²

Kim diagrams Davidson's view of mental events M_1 and M_2 supervening on physical events P_1 and P_2 , to illustrate his claim that having both mental and physical causes would be "overdetermination." Mental causes are redundant and must be excluded.

M_1		M_2
supervenies on		supervenies on
P_1	- causes -	P_2

² *Physicalism, or Something Near Enough*, p. 71



By causal closure of the physical world, Kim says it is the mental events that are superfluous and must go.³

This view of the physical and biological world as made up of isolatable and discrete events is much too simplistic. A physical “event” is subjectively singled out by a human observer from a practically infinite number of biological processes and material events at the atomic and molecular level. The idea of a single “cause” is arbitrarily abstracted from complex processes with enormous numbers of possible causes. A mental event is embedded in a biological system beyond “astronomical” complexity.

The Problem of Mental Causation according to Kim

While the Cartesian mind-body problem was simply the puzzle of how an *immaterial* mind could cause a material body to move, lately the problem of mental causation has been recast as the *logical* resolution of one basic premise and a conclusion, which we might call the standard argument against mental causation:

- The only causes are physical causes. (These causes need not be deterministic. An indeterministic quantum statistical event gives us the probabilities for subsequent events, “causing” them in a way that is not pre-determined.)
- Therefore, mental events cannot cause physical events.

The Emergence of Life from Matter and Mind from Life

According to British Emergentism, there is a hierarchy of levels of organizational complexity of material particles that includes, in ascending order, the strictly physical, the chemical, the biological, and the psychological level. As we have seen, upper hierarchical levels have the power to influence motion in ways unanticipated by laws governing less complex kinds and conditions concerning the arrangements of particles. Emergentism is committed to the nomological possibility of what has been called “downward causation,” control by an upper level of the component particles of the lower levels. We can now demonstrate that the emergentists’ hypothesis is actually realized in biological systems.⁴

3 *Physicalism, or Something Near Enough.*, pp.44-45

4 See chapter 25 for details on emergence.



An informational analysis of non-reductive physicalism must show exactly how *information does not move in the upward direction* between hierarchical levels (fundamentally because noise in the lower level makes motions incoherent), but that *information does move down* as the higher-level information-processing system manipulates individual physical particles (maintaining a high signal-to-noise ratio in the upper level), as the British empiricists imagined.

Some critics think the emergentists' claim is illogical or maybe physically impossible. How can causality be only "one way?" If there are "top-down" causes, there must be "bottom-up" causes by symmetry, must there not? If the contents of the world were only the material particles of physics and chemistry, would not this be so? The short answer is no. The hierarchical organization of material systems, from the galaxies, stars, and planets, to everyday objects like Sperry's wheel, means that atoms and molecules are controlled by causes from above.

The reduction of biology to molecular biology sharpens the question. How is it that some "living" molecules can have power, downward causal control, over others?

We shall see that quantum and thermal noise breaks any upwardly causal deterministic chains between the physics of the atomic and molecular level and the biophysics of the organic world. It also breaks any upward deterministic chains between the neurobiological brain and the mind, replacing them with a statistical causality that provides us with what WILLIAM JAMES called "some looseness in the joints."

We present two biological processes that exhibit randomness in the component atoms and molecules, thus blocking any organized upward influences. The first is present in every biological cell. The other is critically important in the operation of neurons. The first separates the living from the simply material. The latter is at the mind/brain boundary.

Ribosomes Select Randomly Moving Amino Acids

Twenty amino acids move about randomly in all cells at surprisingly high speeds, the consequence of thermal and quantum noise.



Attached to some of them are lumps of transfer RNA, each with three letters of the genetic code that identify a specific amino acid. They bump randomly into the ribosome, a huge macromolecular information processor built from a few strands of RNA and enormous complexes of protein enzymes. The ribosome has just received a message from the DNA in the cell nucleus and is busy decoding its meaning.

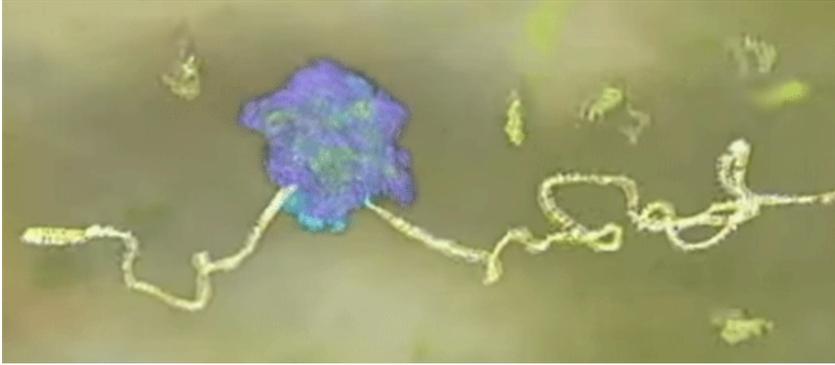
The nucleus had received a signal that a certain protein or enzyme was now in short supply. The signal activated a transcription process that locates the section in the DNA gene with the sequence of three-letter codes that describes the needed protein. Another enzyme called a synthetase moves along the DNA, reads the nucleotide code, and builds a strand of messenger RNA encoded with the sequence that tells the ribosome what is needed.

If this sounds like a number of biological agents intentionally communicating with one another, it is more than a metaphor that they resemble humans using language. They speak in sentences with words and letters. The receivers of the messages take actions that are useful. If the later LUDWIG WITTENSTEIN's definition of meaning in language is the use to which the sentences are put, the ribosome is taking meaningful action.

The long strand of messenger RNA is a script, a text, sent from the cell nucleus, for the purpose that the ribosome will replenish a protein. As the thread of mRNA moves through the ribosome, which adds one amino acid at a time, the random motions of the tRNAs shows us that no organized or coherent information is present in the tRNAs that could cause something from the bottom up to emerge at a higher level. The tRNAs do not know which protein they will soon be part of.⁵

5 See informationphilosopher.com/knowledge/mental_caustion.html/#ribo





Notice the absurdity of the idea that the random motions of the transfer RNA molecules (green), each holding a single amino acid (red), are carrying pre-determined information of where they belong in the protein.

Of course the DNA, the RNA enzymes encoding the message, and the ribosome translating it, do not have the information-processing power to reflect on or become conscious of what they are doing. But their activities are at least proto-mental, because they are very similar to the more symbolic communications of human beings.

It is the information processing of the higher-level ribosome that is in control. As the ribosome moves along the string of mRNA, it reads the next three-letter codon and waits for a tRNA with the matching anti-codon to collide randomly. With over 60 codons for the 20 amino acids, it might be some time before the desired amino acid shows up. It is the high speed of random motions that allows this process to proceed rapidly. Consider the case of hemoglobin.

When a ribosome assembles 330 amino acids in four symmetric polypeptide chains (globins), each globin traps an iron atom in a heme group at the center to form the hemoglobin protein. This is downward causal control of the amino acids, the heme groups, and the iron atoms by the ribosome. The ribosome is an example of ERWIN SCHRÖDINGER's emergent "order out of order," life "feeding on the negative entropy" of digested food.

When 200 million of the 25 trillion red blood cells in the human body die each second, 100 million new hemoglobins must be as-

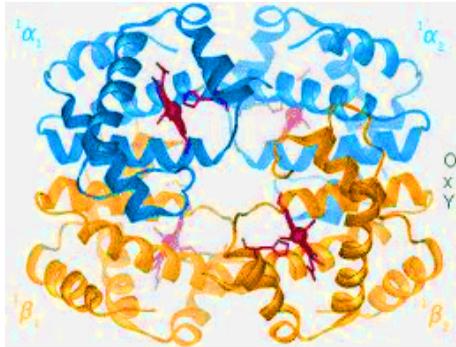


sembled in each of 200 million new blood cells. With the order of a few thousand bytes of information in each hemoglobin, this is 10 thousand x 100 million x 200 million = 2 x 10²⁰ bits of information per second, a million times more information processing than today's fastest computer CPU.

The ribosome is an information-processing biological system that has emerged from the lower level of chemistry and physics to exert downward causation on the molecular components needed to manufacture hemoglobin.

Ion Pumps in Neurons Select Individual Atoms

When a single neuron fires, the active potential rapidly changes the concentration of sodium (Na⁺) ions inside the cell and potassium (K⁺) ions outside the cell. Within milliseconds, thousands of sodium-potassium ion transporters in the thin lipid bilayer of the cell wall must move billions of those ions, two or three at a time between inside and outside the cell wall, to get the neuron ready to fire again.⁶



All the individual ions, atoms, and molecules in the cell are moving rapidly in random directions. The indeterministic motions of the ions randomly move some near the pump opening, where quantum collaborative forces can capture them in a lock-and-key structure. The idea that the physical/chemical base level contains enough information in the motion of its atoms and molecules to cause and thus explain the operations of the higher levels of life and mind is simply absurd.

The emergent biological machinery of a sodium-potassium pump exerts downward causation on the ions, powered by ATP energy carriers (feeding on negative entropy).

6 See informationphilosopher.com/knowledge/mental_causation.html/#ion



The sodium-potassium pump in our neurons is as close to a Maxwell's Demon as anything we are ever likely to see.⁷

When many motor neurons fire, innervating excitatory post-synaptic potentials (EPSPs) that travel down through the thalamus and the spinal cord where they cause muscles to contract, that is as literal as downward causation gets between the mind and the body. When the emergent immaterial mind decides to move the material body, mental causation is realized as downward causation.

Information Solves the Problem of Mental Causation.

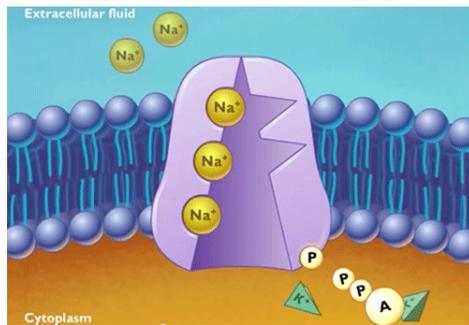
Information philosophy understands mental events as immaterial thoughts, which are normally only unrealized possibilities for action. Thoughts are embodied in the neural information structures of the brain, where they are stored along with memories of past experience.

As such, they are physical and are temporarily even material, in some sense.

But when they are transferred (communicated) to other parts of the brain, out to other minds, or for storage in the external environment, thoughts are converted from a material substrate to various forms of energy. Temporarily, they are quite non-material, as philosophers for centuries have imagined thoughts in an *immaterial* mind might be. Once stored, they are again embodied in matter.

Of course, thoughts or ideas can be unpredictably altered before storage, by noise in the communication. They can also be altered randomly by irreducibly indeterministic errors in the retrieval of the information. Here lies the basis for creative mistakes, to be evaluated by a process of intelligent selection. (As AUGUSTINE noted, the Latin *intelligere* means “to select.”)

The information solution to the mind-body problem can be in-



7 See informationphilosopher.com/solutions/scientists/maxwell/#demon



terpreted as providing a non-reductive physical interpretation of mind. This model of mind supervenes on the neural brain structures that embody the information (while it is being stored). But the intellectual content of the information is not the resultant of whatever physical processes are coming from lower layers in a hierarchical structure. The physical brain is a plastic storage medium adequately determined to store the information content of these immaterial thoughts, and normally to store it accurately.

With reference to popular (if flawed) computational theories of mind, we note that the “software” contents of a computer program, as well as the execution of the program, is in no way determined or “caused” by the computer “hardware.” Similarly, ideas are not determined by the ink on a printed page or the pixels on a computer screen, but by the human minds that put them there.

“Bottom-up” Physical Processes Are Not Deterministic

When small numbers of atoms and molecules interact, their motions and behaviors are indeterministic, governed by the rules of quantum mechanics.

However, when large numbers of microscopic particles get together in aggregates, the indeterminacy of the individual particles gets averaged over and macroscopic adequately deterministic laws “emerge.”

Determinism is an emergent property that shows up in the macroscopic world.

The “laws of nature,” such as Newton’s laws of motion, are all statistical laws, however close they appear to being certain. They “emerge” when large numbers of atoms or molecules get together. For large enough numbers, the probabilistic laws of nature approach practical certainty. But the fundamental indeterminism of component atoms never completely disappears.

It therefore follows that physical brain events are not pre-determined by the events in lower hierarchical levels, not events in the base physical level, nor in the biological level.

And the world is not “causally closed” by deterministic physical laws of nature, as assumed by so many philosophers (e.g., Feigl, Smart, Kim).



Moreover, since some “mental events” are large enough information structures to be adequately determined, these mental events can act causally on lower biological and physical levels in the hierarchy, in particular, the mind can move the body and all its contained physical particles, thus solving the mind-body problem.

A specific example of the mind causing an action, while not itself being caused by antecedent events is the following. Faced with a decision of what to do next, the mind considers several possible alternatives, at least some of which are creatively invented based on random ideas that just “come to mind.” Other possible alternatives might be familiar options, even habits, that have frequently been chosen in many earlier similar situations.

All these alternatives show up as “neural correlates” - brain neurons firing. When the alternatives are evaluated and one is selected, the selected action results in still other neurons firing, some of which connect to the motor cortex that signals muscles to move the body.

Apart from the occasional indeterministic generation of creative new alternative ideas, this whole causal process is adequately determined and it is downwardly causal. Mental events are causing physical body events.

Mind can move matter. Ideas can move mountains.



