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Supervenience and Enablement

The notion of supervenience is a central idea in Anglo-American philosophy's discussions of the mind-body and brain-consciousness relationships. The notion of supervenience is an attempt to think the relationship between body and mind, brain and consciousness or any two related sets of "properties" in a general way. Its classic formulation is

B-properties supervene on A-properties if no two possible situations are identical with respect to their A-properties while differing in their B-properties. ⁱ

For example, if consciousness as a B-property supervenes on neuronal states as A-properties, then any two sets of neuronal states that are exactly the same will have two associated states of consciousness that are exactly the same. It is typically discussed in terms of levels of description. If one is a non-reductionist, then the descriptive differences indicate ontological differences so that reality could be comprised of levels of organization, for example. If one is a reductionist, all of the supervening B-properties are really just A-properties and will be shown to be so as science develops.

Most writers accept that the relationship is asymmetrical. That is, the same B-properties can supervene on different A-properties. Two houses, for example, can have the same dimensions, layouts, interior design and so on though they were made using different kinds of nails. Less trivial examples would be evidence for functionalism where nature can achieve the same ends using different means. Or we can both get the same insight into a circle though our images differ.

There is a seductive logic to the notion so that it appears to support physicalism, especially as formulated by Chalmers where the A facts fix the B

facts. However this allure dissipates if we consider the relation between the two sets of properties holistically. I will illustrate this from two directions. The first is in terms of a program of reductive research exemplified by the work of Erich Kandel. The second is the ontological view of holism where we consider the relations as those of parts to a whole. Considered in this context the notion becomes trivial and its allure rests on an implicit begging of the question.

Erich Kandel is a Nobel Prize winning biologist who studies the neuronal basis of memory. He realized when he entered neural science that the approach at that time needed to be reductive, that is, at the level of the neuron to determine its role in memory. In much of his work he studied the neural system of a snail where he and his colleagues could fully map the neural network that controlled the retraction of the gills when they were touched or when another potentially dangerous stimulus such as a shock to the tail of the snail occurred. They discovered that sensitization, the increase of the strength and frequency of the response, resulted from an increase in the number of synapses on the neurons involved. They subsequently discovered the biochemical processes underlying the development of new synapses as well as those strengthening current synapses.

Though he characterized his research as reductive since it was of the neuron, it was in the context of animal behavior. He says, "Thus, by combining behavioral analysis first with cellular neural science and then with molecular biology, we were able, collectively, to help lay the foundation of a molecular biology of elementary mental processes." Note that molecular biology also was involved but it was used within the context of understanding the cell, the neuron, which in turn led to the understanding of the retention of the changed behavior.

If we cast this example in the terminology of our definition of supervenience above, then we could say that the snail's behavior of retracting its gills supervenes on the neural network and that the neural network supervenes on the molecular biological processes. Now we have something that approaches hierarchy theory which is the context in which most of the discussion of supervenience occurs. There is a difference however. As hierarchically organized the cell would be the organization of the molecular biological processes and the behavior of the organism would be an organization or coordination of the cells. But the notion of supervenience leaves open the possibility that what is a higher level in hierarchy theory is in fact fixed by the lower level.

The counter argument to this possibility cast in hierarchy theory terms is that the relationship is one of organizer to organized where the molecular processes are organized by the cell and the cells are organized by the organism as a whole. Of course there is much more complexity in the actual organism, but our simple three level example works for the sake of argument. A first consideration is that the b-properties are an organization of the a-properties. This terminology is awkward since the notion of property is ambiguous. A more concrete example is that the cell is a whole that has organizations of biochemicals that constitute the processes within the cell. The biochemicals would fix the processes only if they could be uniquely combined in the particular way they are at a particular time. However, they are open to being organized within different types of processes. This indicates that the process as organized “fixes” the role or function of the biochemical versus the biochemicals as an aggregate “fixing” the process as organized.

Another way of putting this is that biochemicals are equipotential in terms of which processes they can be parts. For example, just as the human hand can be used for a variety of tasks, and in human action the same means can be used for multiple ends, serotonin plays different roles. It functions as a neural transmitter, but also regulates intestinal movements.

Another counter argument is in terms of the order of knowledge which is analogous to the ontological order. There are properties that are uniquely studied by each science, and the sciences can be viewed as successively higher viewpoints. Thus, physics can explain aspects of being human, but not all. Likewise with the other sciences. They are potentially ordered as higher viewpoints since we need to understand physics to understand chemistry, chemistry to understand biology, biology to understand psychology, psychology to understand the human sciences and so on. While we can consider the sciences when they are fully explanatory as sets of ordered viewpoints we cannot assume that the ontological order is the same as the order of knowledge. In particular, the ontological order is not a series of levels of complexity. In particular the organism is a whole and there is a sense in which it is its own “level” of complexity. However, the argument does work against what is considered theoretic reduction, which is that physics, or physics and chemistry, will ultimately explain everything.

The discussion gains a greater degree of clarity if we shift the terminology from properties to relations. As noted, the notion of properties is ambiguous. They can be merely nominal, or descriptive, or they can be relational, or explanatory. If we rephrase the definition of supervenience in this way it is:

B-relations supervene on A-relations if no two possible situations are identical with respect to their A-relations while differing in their B-relations.

The first key relation here is the relation of B-relations to A-relations. The second is the meaning of the identity of A-relations. If B-relations integrate, organize or relate A-relations, then A-relations remain as they are and there is a difference between B-relations and A-relations where B-relations are the interrelations of A-relations.

Let us see how this formulation works with Chalmers definitions of logical and natural supervenience. He states:

In general, when B-properties supervene logically on A-properties, we can say that the A-facts *entail* the B-facts, where one fact entails another if it is logically impossible for the first to hold without the second. ⁱⁱ

This means that the A-relations imply the B-relations. But if the A-relations are equipotential, then they admit the possibility of different types of B-relations. The only way for this logical necessity to hold is if somehow the B-relations are immanent in the account of the A-relations. This is exactly the case with Chalmer's account. He states:

When we fix all the physical facts about the world- including the facts about the distribution of every last particle across space and time – we will in effect also fix the macroscopic shape of all the objects in the world, the way they move and function, the way they physically interact... We can imagine that a hypothetical superbeing – Laplace's demon say, who knows the location of every particle in the universe – would be able to straightforwardly "read off" all the biological facts, once given all the microphysical facts... Given all that information, it has all the information it needs to determine which systems are alive, which systems belong to the same species, and so on. As long as it possesses the biological concepts and has a full specification of the microphysical facts, no other information is relevant. ⁱⁱⁱ

Of course if you knew everything about every entity in the universe including how they were all interrelated then you would know the B-relations and the A-relations, but that would not mean that the A-relations entailed the B-relations. In this example, Laplace's demon still has to determine which A-relations are integrated

in which type of B-relations. So this definition of supervenience begs the question. Organization of the A-relations is assumed.

His notion of natural supervenience suffers the same fate. He states:

The weaker variety of supervenience arises when two sets of properties are systematically and perfectly *correlated* in the natural world. For example, the pressure exerted by one mole of a gas systematically depends on its temperature and volume according to the law $pV=KT$, where K is a constant.

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...it is empirically impossible that two distinct moles of gas could have the same temperature and volume, but different pressure. It follows that the pressure of a mole of gas supervenes on its temperature and volume in a certain sense. v

A first error is that this is a statistical relation so there is no perfect correlation between pressure, volume and temperature. This puts his argument in an ideal context, not an empirical one. Secondly, it also follows from his example that temperature supervenes on pressure, volume and the constant K. The constant K also supervenes on the others and so on. In this example supervenience is little more than the relation of A to B where either can supervene on the other. He then goes on to assume that the relations between physical and biological relations have the same law-like structure which permits the physical facts to entail the biological facts as long as the laws are known. He effectively imports necessity into nature via his logical approach but does so by begging the question and abstracting from matters of fact

These notions of supervenience are neither factual nor logically valid. How can we understand the relationships between the brain and consciousness then? Is there a useful notion of supervenience? I have found only one usage of “supervenience” by Lonergan. He uses it in the common meaning of “follows from” or “ensues” when he states that “...insight...(is)... the supervening act of understanding.” An original insight is the emergence of “something new”. It relies on neural processes that enable imagination since insight is into images. There is a concomitant imaginal and neural transformation that “fixes” the insight and makes it a lasting constituent of our mentality. What exactly occurs in the

brain in these instances is not yet known, but it does not seem too much of a reach to think that neurological transformations occur.

We can consider meaning as supervening on speech and speech supervening on utterances and utterances supervening on their imaginal correlates, either the vocal or the written sign. If we follow Saussure, then what enables a sign to be a sign is difference. There is an arbitrariness to signs that enables them to refer. The sign has both a material and a formal element. For Saussure these cannot be separated concretely. The material element is the sound or the mark. Sound as such is not speech. To be speech, sound must signify and it cannot without reference to ideas or concepts. It is by understanding the significance of the sound that we can distinguish words, sentences, etc. He conceptually distinguishes the material and formal elements by distinguishing the signifier and the signified in signs. The signifier is speech, writing or other semiotic elements such as icons and gestures. In the cases of speech and writing, signifiers function via contrast or difference. As purely different they are unmotivated. That is, there is no reason to choose one sound or sequence over another to express a concept. In this sense, signifiers are conventional. If signifiers were not, at root, arbitrary, then some meaning would be imported and the signifier would not be a "pure" carrier of meaning. (Signifiers as motivated contribute to ease of use and understanding of language. For example, regular verb declensions have a root which is retained in all the tenses.)

We know that there are neural areas that are instrumental in language acquisition and use. Damage to those areas results in losses of various language capabilities. Given the arbitrariness or difference of signs we can understand those areas as being equipotential with respect to the languages we are able to learn. Any healthy human raised in a language community will learn the language of the community. These areas do not determine what language is learned; rather they *enable* the learning of any natural language. I would like to suggest that the notion of supervenience, if used to understand the relation of conscious operations to the brain be understood in terms of enablement where the brain enables conscious operations.

There is an analogy between the role of technology and the role of the brain in human behavior. Technology enables different types of behavior but does not fully determine what they are. Likewise, it enables the achievement of different ends but does not determine what they are. Both technology and the brain have

subsidiary roles in human performance. They condition the structure of performance by enabling different types of performance. This notion is compatible with Kandel's reductive research program which combined "... behavioral analysis first with cellular neural science and then with molecular biology..." where we would start with a basic understanding of the B-properties and via research understand how they are enabled by the A-properties.

As a postscript I would like to reiterate this final point by considering the following outline of a research program by Christof Koch who partnered in neurological research with Francis Crick.

Francis and I aim to explain all aspects of the first-person perspective of consciousness in terms of the activity of identified nerve cells, their interconnectivities and the dynamics of coalitions of neurons. This is a bit like playing three-dimensional chess: You must keep simultaneous track of the phenomenology of consciousness, the behavior of the organism, and the underlying neuronal events. It won't be easy, but then no truly worthwhile task ever is.^{vi}

The acknowledgement of the requirement to keep track of three separate areas indicates that the three are interrelated. If so, then all of them cannot be explained only in terms of one of them. Rather they all are understood in relation to one another where in some cases processes in one area are enabling those in another.

ⁱ David Chalmers, "Supervenience" in Emergence, ed. M. Bedau and P. Humphreys (Cambridge, Mass: MIT Press, 2008), p. 412.

ⁱⁱ Chalmers, p. 414

ⁱⁱⁱ Chalmers, p. 414

^{iv} Chalmers, p. 414

^v Chalmers, p. 414-415

^{vi} Christof Koch, The Quest for Consciousness (Englewood, CO: Roberts and Company Publishers), p.314.