

Physicalism Begs the Question and Violates the 2nd Law of Thermodynamics

Physicalism is critically assessed from a natural scientific viewpoint, and its basic principles are questioned. Descartes' substance dualism may seem more acceptable if it is understood as a kind of *energy dualism* where mental and cerebral processes are supposed to be analogous. A strict law connecting (mental) information and cerebral (electrical) potential is proposed. An agent's (mental) concentration on a task, an ordering process, causes cerebral concentration and thereby ordering, i.e., decreased entropy. A purely physical process in the brain without external influence will lead to increased entropy according to the 2nd law of thermodynamics. Since the opposite is true in action there must either be a mental influence or the 2nd law is violated. The physicalists deny mind-brain causal interaction and strict causal laws between the domains. In order to include mental entities in their basic theories they reduce them to physical ones; they may even consider them identical to the latter. This poses a new problem: Animated physical entities/neurons which seem just as "weird and phlogistic" as mind-brain interaction. Moreover, the question of mental efficacy is not properly addressed.

"The core of contemporary physicalism is the idea that all things that exist in this world are bits of matter and structures aggregated out of bits of matter, all behaving in accordance with laws of physics, and that any phenomenon of the world can be physically explained if it can be explained at all." (Kim, 2008, p. 149).

From a natural scientific basis, I will review and comment on fundamental principles of physicalism with respect to mental action and efficacy.

1 Dualism and thermodynamics

Most physicalists hold that mind and brain in dualism belong to distinctly different domains that cannot interact causally. The latter is characterised by space-time coordinates, extension, bulk, mass, energy, etc. which are absent in

the former. Therefore the two domains are incommensurable, and neither substances nor properties can interact causally.

I will ask the physicalists to argue for this assertion with reference to modern physics, not only to Euclidean geometry. Could there be a possible explanation of mind-brain interaction by referring to one or more of the following phenomena, theories, and models in physics?

- *Quantum mechanics*. “Weird” phenomena are discovered and experimentally vindicated at the atomic level, like: Non-locality of particles, statistical nature of the wave function, Heisenberg’s uncertainty principle, and randomness.
- *Dark matter and dark energy*. A large amount of matter and energy in the universe is unknown.
- $E = mc^2$
- *Thermodynamics*. The statistical laws of thermodynamics are not tested for cerebral reactions. A putative influence of mental entities on the 1st and 2nd laws may perhaps some time in the future be experimentally vindicated or at least indicated.
- *Information theory*. Mental information in bits can be converted to physical energy by applying the concepts of both statistical and calorimetric entropy according to L. Boltzmann. A quantitative causal connection is suggested (Løvland, 2009).

Descartes suggests that mental and physical substances interact. This dualism is much criticized, sometimes scornfully, by many philosophers on the grounds mentioned above. That there should exist mental substances is often ridiculed. However, Descartes had solely knowledge of the 17th century’s science and not of to-day’s chemistry and physics. Thus his use of the term “substance” was probably quite plausible at his time but to-day we would prefer to use other terms. Chemical and physical substances consist of a certain amount of internal energy that is determined by their molecular or microscopic structure. In a chemical process the substances are transformed from one structure to another whereby the amount of internal energy changes. In spontaneous processes this energy will normally diminish and the difference between the final and the initial amounts is part of the driving force of the process, in chemistry called the *free energy*; we may also call it potential energy. According to the 1st law of thermodynamics this amount of energy cannot disappear, it leaves the system as heat or as outside mechanical work. In chemical processes the free energy causes changes in the molecular structures on its way to lower energy, a change we may call chemical work. In mental processes motivation, be it desire, libido, wish, will or the like, could be considered as the analogue of free

energy, while cognitive work is the analogue of chemical work. Løvland (2006) has elaborated these relationships in his psycho-energetic model which also includes emotions. Relevant parts of the model are explained below.

Prominent psychologists and philosophers have suggested that mental processes are similar or analogous to chemical and physical ones applying a vocabulary that refers to energy or force, e.g., libido and cathexis (Freud, 1915/1991), psychic energy (Jung, 1928/1973), discourse of force (Ricoeur, 1970), and law of pure wishful thinking (Hart, 1988). If Descartes had used energy terms relating to substances he would have introduced another kind of dualism which would have been more acceptable to contemporary philosophers. An appropriate term would be *energy dualism* that is a possible basis to explain mind-brain interaction. I will revert to this problem below.

Above I said that the change of internal energy is part of the driving force, the free energy. So there are more parts, at least one more. Which one?

If dU is the difference in internal energy between the final and initial substances the free energy of the infinitesimal process is

$$dF = dU - TdS \quad (\text{e.g., Prigogine, 1954}) \quad \text{Eq. 1}$$

where dS is the change of entropy between the substances, and T is the absolute temperature. The very important term entropy, S , is now introduced; in this context it means a small quota of heat per degree. This calorimetric entropy can be converted to statistical entropy by using Boltzmann's constant and his definition of entropy. The latter is grounded of the number of possible microstates and is a measure of order in the substances. It is expressed in the following equation for statistical entropy:

$$S = k \ln m \quad (\text{e.g., Prigogine, 1954}) \quad \text{Eq. 2}$$

which is the Boltzmann-Planck formula where k is Boltzmann's constant and m is the number of possible microstates, i.e., the possible configurations of atoms or molecules. The fewer microstates, the higher is the order, and the lower is S .

Does this physical entropy have a mental analogue? To find out we must turn to information theory that defines the amount of information, which is a mental entity, in the following way:

$$H = \log_2 m \quad (\text{e.g., Attneave, 1959}) \quad \text{Eq. 3}$$

This is a special case of Shannon-Wiener's general equation. m is the number of equally probable alternatives in a choice situation where one alternative is chosen. The fewer alternatives, the higher is the order, and the lower is H , which I prefer to call "mental entropy". We see easily the similarity between equation 2 and 3 indicating an analogous relationship between mental entropy and the physical one. Briefly, when the order becomes higher the lower are both the mental and the physical entropy (and vice versa). Equation 1 relates entropy to energy indicating an analogy between mental and physical energy, i.e., between motivation and physical free energy.

However, here is a contradiction that could make trouble for our mind-brain analogy. H in equation 3 can be interpreted in two different ways: i) Thermodynamicists may call it mental entropy. ii) Information theorists call it information which is the opposite of entropy, i.e., they have different signs. - When the order becomes higher and the mental entropy lower the information increases in a choice situation due to removal of alternatives.

If the first interpretation is applied physical and mental entropy are analogous, but with the second they are not. Which one is relevant?

The contradiction can be explained by the different use of probability in thermodynamics and information theory. Probability underlies statistical entropy and increases in spontaneous physical processes because the number of microstates goes up according to the 2nd law. In mental processes the probability diminishes as the number of alternatives goes up, e.g., when playing dice. I contend that the thermodynamic definition of probability must be applied in order to compare physical entropy and H on equal terms with the same premises. Thus, interpretation i) is preferred, and there is a quantitative analogy between physical and mental entropy. Since this analogy can be extended to energy by equation 1 we have a strong case for dualism which corroborates the theories of mental energy put forward by Freud and others. I deal with this matter in my next paper.

2 Physicalism begs the question

Physicalists have stated two main principles that are crucial and necessary for their philosophy, i.e., for their rejection of causal mind-brain interaction (Kim, 2008):

- 1) *The causal closure of the physical domain.* This means that if a physical event has a cause, this cause must be physical.

- 2) *Causal exclusion*. If an event has a *sufficient* cause *c*, no event distinct from *c* can be a cause of this event.

These principles or axioms seem to be very peculiar to non-physicalists. They are used as premises for a whole philosophy, while others consider them as conclusions that need to be explained, the explanandum so to speak. Just to state that entities in distinct different domains cannot interact does not suffice as an explanation even though one is mental and the other is physical. Batthyany (2005) has succinctly expressed the logical problem of physicalism: 'Physicalism has to presuppose itself in order to confirm itself' (author's translation). King (2006) holds that the principles are not derived empirically but are adopted for methodological reasons.

There is also a real electrochemical ground to reject the two principles above: Without any mental influence energy from the body floods into the brain filling up groups of neurons in a fairly random, disordered, and meaningless way ending up at a certain ground level potential that can be measured with an electroencephalographic method. Neuroscientists (e.g., Libet, 1985; Trevena & Miller, 2002) have measured the potential during an intentional action involving conscious will/desire to move a finger. They found that the potential went up significantly about 10 μV from the ground level, and about 3 μV could be referred to the conscious will. The whole rise is called the cerebral readiness potential. Jung (1985) has demonstrated similar effects that were due to more complex actions such as calculating and writing. When the subjects decided to halt the action in Libet's experiment the potential dropped to the ground level. The experiments show that a conscious and unconscious mental entity caused a change in the electrical potential that can be quantitatively measured. I have suggested an explanation grounded on information theory and thermodynamics for this phenomenon (Løvland, 2009): The mental entity has an amount of information that can be calculated quantitatively in bits, ref. equation 3 above. Both the amount of information and the amount of potential/energy go up when the structural order in respectively the mind and the brain increases. And the mind's order goes up when the subject concentrates on the task. Due to the known correlation between mental and physical entities the brain's order also increases since the mental processes activate relevant groups of neurons while others remain passive, irrelevant, and fairly random. In this way a relatively ordered and meaningful brain pattern is formed. Such ordering is dependent on physical energy being supplied to the brain, and this energy can merely come from the body itself. Thus mental activity causes ordering in the brain *without* transferring energy. The increased cerebral energy is transformed to electrical potential according to electrochemical laws. I held that 1 bit of information causes a change of 3 μV in the readiness potential in Libet's tests (Løvland, 2009). The interaction between the domains is presumably possible due to

“bridge-laws” linking meaningful information to physical energy; we can talk about information-energy interaction.

Now we can conclude that solely “pure” physical laws are never *sufficient* to explain meaningful mental action and efficacy. The mental is needed for intelligent and meaningful ordering in the brain, an ordering that is accompanied by a change in energy/potential. If the ordering in the brain was not caused by mental entities the 2nd law of thermodynamics would have been violated since this law expresses a tendency to lower order. Briefly spoken: The basic principles of physicalism exclude mental causes thereby violating the 2nd law.

The paradox is now that physicalists deny causal mental influence on the physical, yet endorsing mental efficacy. How do they resolve this contradiction? Reduction, identity, and supervenience?

3 Reduction and identity

The main idea behind reductionism is to rewrite a mental law, theory, property, or function in a neurophysiological vocabulary. The mental law must be logically derivable or provable from the physical one (Kim, 1998). It is a requirement that the latter does not refer to the mental law to be reduced if a real “reduction” shall be achieved (Kim, 2008). Certain “bridge” principles grounded on e.g., suitable definitions or empirical correlation laws can then possibly convert the mental entities to physical ones. This conversion (reduction) allows physicalists to explain mental efficacy as a complete physical causal process.

Another theory, combined with or supplementary to reduction, is psychoneural identity. “Strict identity” is governed by the following law: “If X is identical to Y, X and Y share all their properties in common” (Leibniz’s law) (Kim, 1998) (type identity) as in the following examples of Kripkean identities (Kim, 2008):

Water *is* H₂O; heat *is* molecular motion; light *is* electromagnetic radiation.

On my view these are poor examples: We have here *one* phenomenon, not two (X and Y), and water *is* not H₂O, water *consists* of H₂O. Moreover, water, heat, and light do not cause resp. H₂O, molecular motion, and radiation; thus the examples do not illustrate mental efficacy. Another example is more relevant: Pain *is* C-fiber activation. Here we have two phenomena but still pain cannot cause C-fiber activation. A more appropriate example would be: Will *is* cerebral potential. These two phenomena may possibly cause each other, but

do they share all their properties in common? And what is wrong with the more accurate articulation: Will is correlated with cerebral potential.

The reductive physicalists must answer the following questions: How can properties, events, etc. belonging to incommensurable and distinctly different domains, such as the mental and the physical be identical or converted into each other at the “microlevel” when they cannot on the “macrolevel”? Are mental properties “fused” into neurons? If so, who is deciding what to do, who has the upper hand – the mental or the physical? Is there a kind of microcausality inside the neurons? Or are mental and physical properties acting simultaneously?

Kim (2008) advocates a special kind of reduction: Functional reduction. It is supposed to remedy some problems in e.g., Nagel’s bridge law reduction. It is performed in three steps:

- 1) The mental property to be reduced is given a *functional* (causal) definition.
- 2) The properties (or mechanisms) in the reduction (neurophysiological) base, which performs the causal task, must be found.
- 3) A theory that explains how this mechanism performs the causal task must be constructed.

It is easily seen that step 2 and possibly step 3 are tasks for experimental neuroscience. Functional reduction is therefore similar to the plan or research strategy of a scientist who intends to find the cause and effect of a phenomenon. This is exactly what neuroscientists have done. For example, Libet (1985) and Trevena & Miller (2002) have conducted famous experiments, some of which show that the conscious will is the cause of finger movements or lack of movements. We merely(!) have to find the mechanism or law connecting the two entities because “where there is causality, there must be a law: events related as cause and effect fall under strict deterministic laws” (Davidson, 2001; Bechtel, 1988).

4 Deterministic laws

However, Davidson (2001) insists that there “are no strict deterministic laws on the basis of which mental events can be predicted and explained”. I suppose that this assertion can be turned around as a natural consequence which is more relevant to our context: That there are no strict deterministic laws connecting a (purely) mental cause with a (purely) physical effect, a statement that seems inconsistent with the will-finger movement-causality which is experimentally vindicated over and over again. Davidson resolves the inconsistency with his “anomalous monism” theory that invokes mind-brain identity. He holds that the same event is both mental and physical (token identity). Because all mental

events are physical events “they can interact causally with other physical events” according to deterministic physical laws (Bechtel, 1988). Davidson’s definition of identity differs from the type identity presented above: He states that *one and the same* event has different properties, both mental and physical, and that the event belongs to the same domain; thus we have monism, not dualism, and it becomes easier to connect mental and physical events by laws.

But even Davidson has to answer the following questions: At the dualistic “macro-level” the main principles of physicalism exclude mind-brain causal interaction. Why is this possible at the “microlevel” even if the two domains are reduced to one? How can properties from such incommensurable domains be parts of the same event at this level? Do they interact inside the event and not outside? Or do they fuse inside an event? If so, does this mean that physical entities are animated? Do we then have a kind of animism? On my view this seems to be quite “phlogistic” and not more probable than causal interaction at the macrolevel. If the mental and the physical are separate entities within the same event, the latter entity will comply with deterministic laws. But are we certain that also the mental ones do likewise? Do the mental entities get a “free ride” with the physical ones? Moreover, not even Davidson has clearly explained who has the upper hand. Who decides, the mental or the physical? If we are not going to end up with epiphenomenalism the mental must take the command in action. Does it, and how?

Davidson’s logic is fascinating but he forgoes a fundamental question: What is really an event? It is described and observed by its properties, but properties alone have no driving force; there must be “something” underlying the properties. In the physical domain it is substance/energy. What is it in the mental? I revert to my idea presented above: The function of energy and force and the inferred idea of energy dualism. Mental events (processes) behave as if they were driven by energy, which we may call psychic energy (Løvland, 2006). To explain the latter we have two options: 1) Either it is real mental/psychic energy that we unfortunately cannot measure directly with our physical instruments. 2) Or the underlying energy is physical/physiological that is (strictly) correlated with mental entities. – Both these options are based on mental-physical dualism and need bridge laws in order to explain interaction. Option 2, however, could comply with Davidson’s monism based on (token) identity in that the same event consists of both mental properties and physical energy within the same domain. But this does not explain mental efficacy. Davidson merely moves the problem of bridge laws from two domains to one, actually to the event itself, and we still need an explanation of the mental as a cause.

5 Conclusions

Mind and brain as separate domains are related due to the concepts of energy, entropy, and information. Processes in the mind are considered to be analogous to physical ones such as these are formulated in chemical thermodynamics. A crucial point is that motivation is the driving force in the former, and free energy in the latter, i.e., mental energy versus physical connected by entropy and information.

In mental action will can enhance electrical potential in the brain, and a strict law based on information and entropy is proposed.

The 2nd law of thermodynamics is violated by the physicalists since their purely physical model should lead to more disorder while increased cerebral order is the observed fact.

The physicalists reduce mental processes to physical ones and consider them identical whereby they contend that mind is matter. Since they agree that mental properties exist these must then be included in matter, e.g., neurons. Then we have “animated” matter that seems quite weird, and does not make it easier to resolve the mind-brain problem.

I conclude this paper by presenting a metaphor for the mental’s supremacy over the physical in intentional action: The conductor of an orchestra determines the performance of the players without touching them physically, just as the will determines the behaviour of neurons.

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