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## Chapter 15

# A dialogue concerning the mind-body problem

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### Abstract

Three monist views on the mind-body problem are presented. Triple-aspect monism considers that there are three main phases of actualization of the potentialities in Nature: the physical, the informational, and the conscious. The double-face view assumes that conscious mind and brain are irreducible to each other, stressing not only that the conscious mind is dependent on the brain, but that changes in the brain are also dependent on the conscious mind. Qualitative physicalism adopts the mind-brain identity thesis, and defends the view that subjective qualia are actual physical attributes of some region of the brain.

### 1. Introduction

**Oswaldo:** Let us enjoy the boat trip from Ilha Grande (Big Island) to Angra dos Reis, in the coast of Rio de Janeiro, chatting about *the place of mind in the physical world*. I would like to start by asking whether we all agree that there was no mind in Nature, say 4 billion years ago, before the emergence of life on Earth.

**Jonas:** Yes. Roughly speaking, evolutionary biology allows us to state that the emergence of the conscious mind is relatively recent in the history of the Universe, only getting into existence when and where matter acquired, by genetic inheritance and natural selection, a particular kind of organization, a nervous system with a specific level of complexity. Based on this approach, it is reasonable to defend that the conscious mind is not a fundamental entity, independent and separate from the physical world, but a specific phenotype, i.e. an adaptive property of living matter, through which it has been acquiring, in its interaction with other physical and biological beings, specific levels of complexity.

### 2. Triple-aspect monism: an overview

**Alfredo:** I would like to speak from the perspective of *triple-aspect monism* (TAM), which intends to overcome the dichotomy of between materialism and idealism, as well as dualist attempts to save the appearances of both (see Pereira Jr., 2014). The ontology of TAM is based on the three main phases of actualization of the potentialities of Nature. The potential states are actualized in three ontological categories, according to an order (each aspect being a condition of possibility for each other). TAM does not attempt to explain the three categories in a metaphysical fashion; they are assumed to be fundamental aspects of reality, being actualized in any place and time when adequate “conditions of possibility” are satisfied.

TAM focuses on scientific concepts that afford explanations for the conditions of possibility of each aspect: a) Physical: refers to matter/energy in space/time. b) Informational: refers to complex forms being transmitted between physical systems. c) Conscious: refers to experiences of systems in which there is a feeling about the content of the information they process.

The immediate actualization of elementary energy forms is the physical aspect, characterized by the presence of matter. The structure of the physical space-time is defined according to the structure of matter/energy. In the universe or multiverse, there are regions where only the first aspect is actual. For instance, in a planet where material systems are in thermodynamic equilibrium, evolution stops in the first phase. In other planets there may be low entropy, and then the second aspect becomes actual (for instance, chemical clocks spontaneously appear).

**Oswaldo:** Okay, so we all agree that at a certain time, on planet Earth, there were no minds, and somehow they emerged. Your triple-aspect monism seems to me to be an original position. It is a form of monism, to which I agree, since I spouse a radical form of materialism, called “qualitative physicalism”.

### 3. The double face view: an introduction

**Jonas:** My view is also monistic, in the sense that there is only one “substance”, but is a form of Property Dualism. (I) Assuming that consciousness is the essential property of the mind, I propose a “double face view” of the mind-brain relationship, according to which *conscious mind* and *brain*, besides being essentially *distinct and irreducible*, are *dependent and inseparable*.

Before presenting this view, let me specify the notion of “mind” here considered. I assume both that consciousness is the essential property of the mind, the “central mental notion” (Searle, 1992, p. 83), and that conscious states always have contents: someone is conscious of something. So, we can ask “what is it like to be an individual A”, paraphrasing Thomas Nagel famous article (1974), if we want to know how is the *subjective experience* or *phenomenal consciousness* of the individual A, including sensations, feelings and thoughts. For example, we may ask how is it to *feel* thirsty, sad or guilt, to *see* a red apple, to *pay attention* to a dangerous animal, to *remember* a scary experience, to *imagine* the future, to *reason* to win a chess game or to solve an equation, to *have concepts* such as color, time and black hole, to *believe* in God, to *wish* to get married, and so on.

**Oswaldo:** William Hamilton (1877, p. 191), the Scottish philosopher, claimed that one cannot actually “define” consciousness, since it is at the root of all knowledge. You are giving a kind of ostensive definition, saying that consciousness is that what you are experiencing right now!

**Jonas:** Yes. (II) But let me talk very quickly about the first pair mentioned before, the *distinction and irreducibility* between conscious mind and brain, a thesis assumed by the “double face view”. I think that it is legitimate to say that conscious states and processes are not physical, in so far as they are not described by properties usually ascribed by physics to the physical world, like waves, particles, forces, etc. It is known through introspection that conscious states and processes exist and, at least in some degree, it is known what they are, even being difficult to describe them, and one does not need any kind of scientific knowledge to understand what they basically are, qualitatively speaking; on the contrary, science will depend on the limited description derived from introspection to find out the physical correlates of the events and processes of the conscious mind. So, according to the “double face view”, the conscious mind cannot be reduced to physical events like brain states or processes, by identification or elimination, and just be explained as a property of brain states and processes in their interactions with the body and the physical and sociocultural environment. However, as I will argue ahead, this is not a Cartesian view, that is, *conscious mind* and *brain* are not

two substances, which, although connected, could exist separately and independently of each other.

#### 4. Qualitative physicalism

**Oswaldo:** I disagree that mind and brain cannot be considered identical. But what the heck, every philosopher of mind has his own metaphysical position! Here we are, on a small motor boat sailing through rather rough waters in the Big Island Bay, three philosophers of mind returning from a conference in some small corner of the Earth, as thousands of others do all around the world, each with a different opinion. Will there be some scientific revolution in Neuroscience, Psychology and the Philosophy of Mind, that will unify our views on the mind/body problem?

I believe so. And I think the beginning of the revolution will take place when empirical scientific research establishes where in the brain is the seat of consciousness, what part of the brain is the immediate (or most proximal) cause of consciousness, or identical with it, as in my view. My view is also monistic, but I attribute a special role to the *mind-brain identity thesis*. When we see a red pitanga berry, as those we avidly ate at Two Rivers Beach, the redness is not in the actual fruit, but somewhere in our mind, as formulated by Galileo and subsequent classical philosophers. This is an “internalist” view on colors and other qualia. But assuming the mind-brain identity thesis, it follows that colors are located in our physical brains. Adopting physicalism, one finally concludes that colors and other sense data and emotions are real properties of our brain tissue.

**Jonas:** If you say that redness is in your brain, why doesn't your brain tissue actually look red? I mean, forgetting that it's full of blood.

**Oswaldo:** When you look at a pitanga in sunlight, light is absorbed selectively on the surface of the berry, with longer wavelengths of light being reflected to your eye. However, when you look at the region where redness is produced in someone's brain, the tissue does not selectively reflect light in the same way as the pitanga does, so it will not look red for an outsider. This metaphysical position, called the “colored-brain thesis” by Stubenberg (1998, p. 169), actually put forth by Thomas Case (1888), and which I rather name “qualitative physicalism”, claims that subjective qualia or sense-data are physically as they appear. This is a materialist version of “Russellian monism” (Alter & Nagasawa, 2012), as developed by Mach, Schlick and Russell: science has only access to the structure of reality, to the relations between things, while our only access to the thing-in-itself or to the inscrutables of reality is in our subjective experience, which these authors take to be sense-data, in the so-called “neutral monism”.

Inspired by Mary's room thought experiment, qualitative physicalism separates the quantitative-linguistic description of colors that Mary has inside her room

devoid of colors (a theoretical scientific description) from the qualitative experience she has when she actually sees a color for the first time (acquaintance). There is clearly an explanatory gap between the qualitative experience and the theoretical description, which neuroscience in the future will bridge with psychophysiological bridge laws that will have to be taken as principles (therefore unexplained).

#### 5. The three actualizations, according to TAM

**Alfredo:** I follow Jonas in distrusting the identity of mind and body. But I think one needs to include a third aspect to account for reality, which is information. In triple-aspect monism (TAM), Nature is conceived as the totality of existence; a mind-independent eternal reality, composed of interacting, self-organizing elementary energy forms. The elementary forms can be compared to an “alphabet” of reality – or to Plato's Ideas, in the Aristotelian interpretation (they are not placed in a separate realm, but embodied in Nature). Elementary energy forms are claimed to exist eternally *in potential states* (another difference from Plato's Ideas). We do not observe or experience the elementary forms themselves, but only their combinations. Their practically infinite combinations define different kinds of evolutionary processes that occur in different regions (for instance, in the planets of the solar system).

The ensemble of all possible combinations of elementary waveforms define the State Space of Nature, a N-dimensional structure where all possible dynamical evolutions of Nature can be identified. In TAM, the quantum wavefunction is conceived as composed of real, interacting, superposed and entangled elementary energy forms. At each measurement, the complex of interacting forms decoheres, generating a macrostate with fixed properties (quantitative and qualitative). We can directly measure and register the properties of the resulting macrostates.

“Self-organization” refers to the activity of systems composed of dynamical interacting independent units generating new phenomena. Cournot's concept of *chance* was used by Debrun (1996) to approach the dynamics of self-organizing systems. It is not identical to the concept of *randomness*, but refers to the semi-deterministic process of interaction of statistically independent units, generating what could be called “relational collectives” (Lungarzo & Pereira Jr., 2009).

**Oswaldo:** So, this is the first aspect, the physical one, that existed before living creatures. I assume that when you talk about “quantum measurement”, you also include “environmental monitoring”, which also leads to decoherence without the presence of an intelligent being.

**Alfredo:** Yes. Now the second actualization builds on complex forms generated by the combination of the elementary ones. This aspect of Nature contains all

laws and principles of Nature: mathematical relations, logical inferential rules, information patterns, etc. Rules of Nature do not exist in the void; they are the results of the systematic self-organization of the elements. This aspect was largely expanded with the emergence of biological systems that exchange all kinds of signals internally, with other living systems and with the physical environment.

The third actualization we know about is conscious experience. It occurs when a system feels the information it processes. When complex patterns are formed and transmitted between material systems, the second aspect is present, but it is not sufficient for the third aspect; something more is needed: the existence of systems able to feel the meaning (for themselves) of the informational messages (e.g., to recognize regularities in the chemical clock as temporal rhythm). Feeling is an affective state characterized by the capacity of the information to *globally* affect (or to *cause*, in the sense of Aristotle's Formal Cause) the physical structure of the system.

**Oswaldo:** I see... It is curious, because I would consider the informational aspect as simply the patterns or arrangements of matter, something pertaining to the material realm.

### 6. The double face view: inseparability of mind and brain

**Jonas:** Well, let me continue presenting the "double face view" of the mind-body relationship. I have stressed the distinction and irreducibility between mind and body. (III) Now I will talk about the *dependency and inseparability* between *conscious mind* and *brain*, the main point I wish to stress here. First, to explain the *conscious mind* it is necessary to consider the *brain* (conscious mind → brain), for the structural and functional organization of the *brain* is the cause not just of the existence, but also of the properties – form and content – of the conscious mind.

(IV) Second, to explain the structure and functioning of the *brain* the *conscious mind* has to be considered (brain → conscious mind), for the *conscious mind* is responsible, at least in part, for the structural and functional organization of the brain. Let me develop little bit more this "double face view".

(V) The thesis that the structural and functional organization of the brain is the *immediate cause*<sup>1</sup> of existence, form and content of the conscious mind –

<sup>1</sup> To consider the brain as the immediate cause of the conscious mind does not mean to disregard its mediate causes, such as the body and the physical and sociocultural environment, without which the brain would not exist and would not be structurally and functionally what it is.

*conscious mind as brain* – has been endorsed by evolutionary biology and neuroscientific research.

The assumption that the brain is the immediate cause of the conscious mind has also been supported by countless neuroscientific studies, most of them published in the last 30 years, which use different methods of research and a variety of technologies that allow to peer into the normal and abnormal brains during and after cognitive, affective and behavioral tasks. This sort of research has fostered the development of therapeutic practices targeting cognitive, affective and behavioral dysfunctions, by manipulating the brain, for example, chemically and electromagnetically, changing its structure and functioning on both levels, macrophysical and microphysical. Pointing to the same direction, there is a wide research program, which includes: studies of brain injuries and its implications to emotional, cognitive and moral behavior; brain-machine interface; cranial electromagnetic stimulation, and the development of drugs targeting mental illness, emotional states, cognitive skills and moral behavior.

**Oswaldo:** I subscribe to this view. We could say that the mind "supervenies" on the brain (and not only on the body or the whole environment). One could push this even further, and postulate a localizationist thesis: that phenomenal consciousness also supervenes on a rather small region of the brain. But this issue is an open question for neuroscience, whether the proximal cause of consciousness is localized (Bogen, 1995, suggested the thalamus, others the posterior prefrontal cortex) or whether it is distributed as a dialogue between thalamus and cortex (Llinás & Ribary, 2001).

Oh, I'm feeling seasick, with the rolling waves.

**Jonas:** Lie down on the floor, belly up! Let me continue.

(VI) So, I think that there is sufficient evidence to assume that the conscious mind is a property of the brain, and as I will argue next, an embodied and situated physically and socioculturally brain, so to explain how the brain produces the conscious mind would depend on understanding how the brain works, no doubt a tough problem, but not an insoluble mystery.

The other thesis of the "double face view", that the structural and functional organization of the brain depends on and is inseparable from the conscious mind – *brain as conscious mind* – is also supported by contemporary research in neuroscience, from which it can be inferred that the brain, besides being physically embodied and situated, is also conscientiously embodied and situated. I mean that, via conscious mind, though not exclusively, the brain interacts with its body and with the physical and the sociocultural environment in which it is immersed. The sense organs and proprioceptive/interoceptive structures of the body are here considered as a kind of window that allows the brain, which is inside of the head, to interact with the body, where it is located, and with the physical and sociocultural environment, where it is situated, being consciousness

– the essential property of the mind – one specific property of the brain, which is present in all of those windows. It is known that the brain interacts unconsciously with physical stimuli through the sense organs and proprioceptive/interoceptive mechanisms, however I would like to stress here the ability of the brain to interact via consciousness with both, the physical and the sociocultural environment. What the brain is and what the brain does is inseparable from its structural and functional architecture, genetically constructed and, as studies of brain plasticity show, resultant of brain interactions with the physical and sociocultural environment.

So, the structure and functionality of the brain depends on both, preinstalled cognitive and emotional capabilities built genetically, and the physical/sociocultural environment, which affects the brain thanks to its ability to interact with the body and with the external world via its conscious mind. Regarding this aspect, contemporary neuroscience has shown that the brain is not only modified when it is physically altered by sensory stimuli, injury, surgery, chemical and electromagnetic manipulation, etc., but also, thanks to its plasticity, by many different kinds of physical and psychological experiences. As shown by a paradigmatic definition of brain plasticity, there is an essential relationship between brain changes and experience: “we can define brain plasticity as the capacity of neurons and of neural circuits in the brain to change, structurally and functionally, in response to experience” (Sale et al., 2014, p. 190). What neuroscientists in general do not specify, but I am considering as fundamental, is that what is said about *experience* can be interpreted, at least in many cases, as conscious experience. So, I am here specially thinking about the relationship between *conscious experiences* and brain plasticity. By exposure to sociocultural practices, such as those related to a regular education, a child, by mean of its conscious mind, has its brain modified, so the sociocultural learning is not an abstraction, separated from what happens in the brain.

### 7. The material correlates of consciousness

**Alfredo:** The identification of sufficient conditions for consciousness is a huge task for scientific research. According to TAM, feelings are related to wavelike processes that affect living systems. Plant tissue, having the morphology of a syncytium, may probably be able of forming hydro-ionic waves that would correspond to a primitive sensibility to conditions as environmental heat or sound. In the brain and body of animals, sentience is possibly related to wavelike activities in glial cells, extracellular and cerebral fluids, blood and muscles. The evolution of neuronal networks endows animals with more and more powerful cognitive capabilities – instantiated in specialized neuronal circuits – that expand the capacity of feeling that begun with plants. In the human species,

consciousness can be conceptualized as *cognition with feeling* (or feeling improved by cognition).

There are two kinds of information processing in the brain. One is by means of electric pulses (action potentials) in neuronal networks. The other is by means of hydro-ionic waves guided by proteins, in glial cells, extracellular medium, cerebrospinal fluid and blood flow. While the main physiological activity of neurons is the electrical action potential – composed of fluxes of sodium and potassium ions through the membrane, activating molecular and biochemical processes at the synaptic cleft –, astrocytes have internal calcium waves that cross the entire network and control the concentration of extracellular potassium.

Neurons receive and process information from the environment and the body, and control behavior, while astrocytes receive information from neurons and blood, but do not directly control behavior. There is an increasing evidence for the hypothesis that brain tissue waves, having the astroglial network as a “Master Hub” (Pereira Jr. & Furlan, 2010), instantiate conscious feelings and modulate neuronal cognitive processes, according to the valence of the feeling (reinforcing when it feels good, and depressing when it feels bad). The above hypothesis illustrates how conscious activity is instantiated in the living body according to TAM. The feeling of qualia (e.g., color) comes from the dynamic waveform instantiated in brain tissue, having the astroglial network as the hub that mediates the effect.

The philosophical concept of the relation of the conscious mind with brain activity that results from TAM is that conscious activity is a fundamental aspect of reality, not (epistemologically or ontologically) reducible to the physical or informational aspect, but requiring the actualization of both (i.e., requiring the existence of physical systems that process information and feel the meaning attributed to the message).

### 8. The mind-brain identity thesis

**Oswaldo:** I have a similar view concerning what you called “instantiation of conscious feeling” in the brain tissue. Relying on the mind-brain identity thesis, I would say the redness of the pitanga berry is identical to a certain region of the brain, which consists of tissue made of nerve cells (neurons and glia) fed with complicated spatiotemporal patterns of electrochemical impulses from the neurons. The patterns themselves, which could be generated in a computer, are not sufficient to emulate consciousness, since biological matter is taken to be essential for consciousness. This is a version of Searle’s (1992) “biological naturalism”, a position that is opposed to “machine functionalism”.

The mind-brain identity thesis seems necessary for any materialist view. If a thought arises from the brain but is not identical to a part of it, then it must be

hovering above the brain tissue, but where is it located in the physical realm? Maybe it is an electromagnetic field produced by the brain, but then it is identical to the field. Maybe it is an emergent property of the brain tissue, but then one would have to admit that there are also emergent physical properties, so the simplest explanation for the physicalist would be that the mind must be identical to such an emergent physical property. The identity thesis seems inescapable for the materialist, but it should be used appropriately, and not as done by Paul M. Churchland (2007, p. 120), who proposes that “the sourness of a spoonful of lemon juice [...] is identical with the relative concentration of hydrogen ions in that liquid”. According to qualitative physicalism, the sourness is identical to the physical components of a certain internal brain state, not to the external physical state of the juice or of the tongue.

Churchland's view is similar to U.T. Place's, in attributing to subjective qualia a secondary status, something that is clearer in Feyerabend's (1963) version of identity theory, which eliminates mental concepts altogether. Place's identity thesis is in fact an eliminative thesis, as is clear in his statement that there is a “phenomenological fallacy” in the claim that the greenness of an after-image experienced by someone is “a literal property of objects”, since there isn't “anything green in his brain” (Place, 1956, p. 49). The famous example that Place gives of the identity thesis, that “lightning is the motion of electric charges” (p. 47), is the comparison of two linguistic-quantitative statements, and is therefore non-problematic. The problem arises when comparing a subjective experience and a physical description of the brain. The identity thesis is the correct step, but Place was not willing to buy the colored-brain thesis with which Boring had flirted, “which for a philosopher would constitute an immediate knockdown *reductio ad absurdum* of his position” (Place, 2000, p. 1). The claim that a subjective state of pain is identical to a neurological state should not eliminate the subjective qualitative state; one should bite the bullet and recognize that the pain is a physical attribute of the brain (since the mental state is identical to the physical state).

There are many versions of the mind-body identity thesis. Any monistic view must identify mind and brain in a fundamental level. One may claim Spinoza had an identity view, since for him, as well as for Fechner and more recently Thomas Nagel, mind and brain are two aspects or perspectives of a single fundamental entity. The first expression of the identity thesis appeared with the materialist Democritus, and according to Aristotle (*De Anima*, I.2, 405a9) “soul he regards as identical with mind”.

### 9. The double face view and the causal role of the conscious mind

**Jonas:** From what was said about the relationship between *conscious mind* and *brain*, the “double face view”, I infer that the causal action of the first on the

second is not unintelligible, and is not a mystery as well. What turns mental causation unintelligible is a misleading formulation of the problem, which does not distinguish *dualism of property* from *dualism of substance*. In a formulation of the problem of mental causation, “how can the conscious mind, being a non-physical property of the brain, act causally on the brain?”, the conscious mind is treated as if it were a non-physical substance, which, by itself, would have a causal power on the physical brain, so being really an unintelligible relationship. However, taking seriously the idea that the conscious mind is a property of the brain, a distinct formulation of the problem of mental causation would be more appropriate, like: “how does the brain, guided by its conscious mind, act causally on the brain?”. Now the conscious mind is considered as a non-physical property of the brain, by means of which the brain acts upon itself. What I am proposing here is to focus on the causal power of the brain derived from the fact that it has a conscious mind, which requires, as said before, an understanding of how the fact that someone has a conscious mind determines the structure and functionality of the brain and, consequently its intentional action on the body and external environment.

So, to accept that the brain plays an essential causal role, being causally responsible for conscious events and processes, does not imply the exclusion of the causal power of the conscious mind, that is, it does not render the conscious mind a mere epiphenomenon or “shadow” of the brain. Even if one accepts that the contents of consciousness depends on brain structure and functioning, in its relationship with its body and external physical and sociocultural environment, that does not prevent the conscious contents of being responsible for changes in the structure and functioning of the brain. To sum up, according to the double face view here presented, the *embodied and situated brain* is the organ of the *conscious mind*, and the *conscious mind* gives the *brain* causal powers which the latter would not have without its *conscious mind*, being as legitimate to ascribe a causal power to the *conscious mind* (not by itself as if it were a substance) as it is justifiable to attribute causal power to the physical and sociocultural environment, which, by changing the *brain through its conscious mind*, provides the most part of the contents of the conscious mind.

**Oswaldo:** Our trip is ending, we're arriving at what once was a beautiful coastal town, Angra dos Reis, but which is now full of shanties...

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## Chapter 16

## Machine learning and the probabilistic modeling of cognition and behavior

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### Abstract

This text is a discussion of machine learning, especially probabilistic modeling using Bayesian statistical inference, based on three general questions. The authors acknowledge the importance of Bayesian methods, but recommend that they be complemented by other approaches. Automated decision making in the medical sciences is also examined, as well as aspects of the machine techniques of Deep Learning, the training procedures of which are compared to the maturation of the human brain.

### 1. Mathematical modeling of cognition

*In the project of modeling cognition using mathematics, among the many mathematical structures at our disposal, which should be used? Should Bayesian statistical inference be preferred?*

**Peter:** In the first place, it is important to make a distinction between the use of mathematical constructs in a methodological sense, to help understand the cognitive architecture and neural implementation of cognitive processes, on the one hand, and the hypothesis that mathematical constructs are direct equivalents of elements of cognitive processing. One can, for example, use methods available

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Cognitive Science: Recent Advances and Recurring Problems

Fred Adams  
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