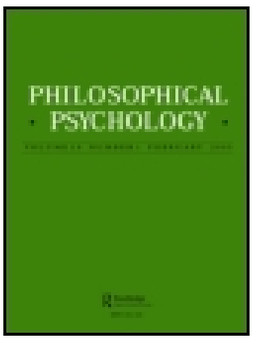

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Mind–body unity, dual aspect, and the emergence of consciousness

JOSÉ-LUIS DÍAZ

ABSTRACT *Dual aspect theory has conceptual advantages over alternative mind–body notions, but difficulties of its own. The nature of the underlying psychophysical ground, for one, remains problematic either in terms of the principle of complementarity or if mind and matter are taken to be aspects of something like energy, movement, or information. Moreover, for a dual aspect theory to be plausible it should avoid the four perils of all mind–body theories: epiphenomenalism, reductionism, gross panpsychism, and the problems of emergence. An alternative dual aspect theory, patterned process theory, is introduced and defended in neurological and individuality terms. The concept is grounded in a brain model of hierarchies wherein consciousness is conceived to be a cognitive aspect of the highest emergent brain inter-module activity, which is situated in the context of a living organism coping with a changing environment. The notion of individuals as psychophysical units unfolding as patterned processes is shown to constitute an integrative approach to brain, consciousness, and behavior that can avoid the conceptual perils and meet the ontological requirements of dual aspect reality and thereby advance the foundations of an integrative mind–body science.*

The advantages of dual aspect

Suppose that the mental and the physical are aspects of one and the same thing. There are advantages in doing so. For example, we would enjoy a monist ontology and a duality of properties and perspectives. Moreover, a dual aspect causality would leave behind ineffectual epiphenomena, reductive identities, and the mesh of causality difficulties in supervenience or emergence accounts of the mind. A dual aspect ontology does not posit causal relations between brain and consciousness because there is only one (psychophysical) process subjected to normal causal process laws. Finally, a dual aspect ontology allows for scientific mental-term-to-physical-term correlations which could eventually become psychophysical laws if such correlations were proven to be more than mere statistical covariances and offered causal explanations supported by empirical evidence coming from psychobiology, internal psychophysics, or cognitive neuroscience.

The idea that mind and matter are two aspects of a single reality has a long history (Díaz, 1989), and theorists as diverse as Merleau-Ponty (1942/1963) and

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Strawson (1959) recognized that no metaphysics of mind is as sound or plausible as dual aspect theory. If we refer to Baruch Spinoza, the father of modern dual aspect theory, we find not only the original notion that there exists only one substance with both mental and physical attributes (Curley, 1969), but also three derivative mind–body propositions: (1) mind consists in "presentations" of bodily states; (2) such presentations are the states of the body as perceived from its "inside"; and (3) mind and body belong to a state of presentation of the physical world (Sprigge, 1977). Is it possible to actualize these propositions? Certainly. In terms of modern neuroscience it could be said that a content of consciousness is a *direct perception* of a particular brain activity. In turn, *direct perception* can only be interpreted as the mental and subjective aspect of a highly structured inter-module brain activity. In this case such brain activity is neither the cause nor the effect of consciousness because we are dealing with one single process that has two facets, one objective aspect suited for third person analyses and the other a subjective aspect that can only be described from a first person perspective. In a similar vein, in Bertrand Russell's "neutral" monism, mind and matter are different constructions from the same neutral (neither mind nor matter) reality (Russell, 1927; Tully, 1993) and, therefore, consciousness would not be realistic about the appearance of objects (as sustained by the New Realists) but in reference to brain activity. Let us take a closer look at this peculiar idea.

According to Lockwood (1989), Russell's identity theory has the advantage over other identity theories in that it does not reduce mind to matter because it considers the physical world infused with qualities which constitute the basis of its causal powers and which include immediately *introspectible* qualities in their own right. Thus, phenomenal qualities would be intrinsic attributes of matter as disclosed by awareness, to which we have a special and privileged access. This means to say that via some unknown brain activities we have access to an intrinsic character of matter, namely, *to such brain activities themselves*. Perhaps a more correct way of putting this (especially if we are to avoid the riddle of the "I") would be to say that part of the intrinsic character of the highest properties of brain activity is the feature of awareness. In this sense, introspective first person accounts would be accounts of brain activity. Not far from this stance, Russell's colleague Alfred Whitehead (1929/1978) proposed that each organic system is a rapidly evolving series of bipolar momentary events ("actual occasions") simultaneously existing in a subjective and objective mode. This concept has become a central tenant of modern process philosophy (Griffin, 1989; Rescher, 1996).

Of course not everything is smooth. If a dual aspect theory is to be plausible in the present it should avoid the main perils of mind–body theories: epiphenomenalism, reductionism, gross panpsychism, and the problems of emergence. Even if a dual aspect ontology and neutral monism could entail conceptual advantages over other mind–body ontologies, they face a major problem in defining and analyzing the neutral ground and the mechanisms of their dual appearance. For example, in his analysis of the causality involved in the will and in movement, Brian O'Shaughnessy (1980) arrives at a dual aspect concept of action but remains silent about the relationship between brain and consciousness. The traditional dual aspect

interpretation about this relationship is that the mental and the physical are explicit aspects of X, an underlying object or process. As we shall see, proposals for X include energy, an implicate order, quantum mechanical functions, or information. But there are problems with these proposals. For example, some one or another character of either the mental or the physical is misinterpreted or misdescribed. If, for example, X is information, then it is difficult to explain why some mental activities are conscious because mere information need not be conscious. One possibility for overcoming this problem is to use the principle of complementarity.

Janus—face complementarity

To account for the neutral ground between the mental and the physical, a dual aspect theory was developed in 1969 by Brody and Oppenheim invoking Niels Bohr's principle of complementarity in quantum physics. According to this principle, either light or electrons could be construed as either particles or waves depending on the experimental setting used to analyze them.

Nevertheless, through its widespread uses and applications, complementarity has become a fuzzy concept, allowing at least four different interpretations: (1) when a single object or process can independently appear through different perceptual channels (as in the case of the light, sound, and electrical discharge "aspects" of a thunderbolt); (2) when a single object or process can independently also appear through different phenomenological facets such as the multiple "aspects" of music (*behavioral* digitization and stance, *physical* string, vocal cord and air vibrations, *neurophysiological* auditory potentials or cortical activation patterns, and *mental* representations or emotional states); (3) when some aspects of an object are explained in terms of one frame of reference while others are explained in terms of another (such as different biological, psychological, or sociological theories accounting for a given behavior); and (4) when the explanatory characterizations of a single object or process appear as logically incompatible levels of discourse (the Copenhagen interpretation of the wave–particle nature of light). Thus, if the mind–body problem and, specifically, dual aspect theory are to be framed in terms of the principle of complementarity, it is necessary to do so in reference to these interpretations.

Based on the complementary "bi-perspective" notion of Brody and Oppenheim (1969), Gordon Globus (1973) advanced an idea which is an instance of the second interpretation: the notion that psycho-neural identity is not resolved by simply identifying or reducing a mental event to a neurophysiological event, but by considering consciousness as a "pure event" that, from an observer's point of view, is realized by the brain. Globus asserts that the same event appears very different to the experiencing subject and to an observer of the subject's behavior or brain activity, but that these are "methodologically equivalent" observations. Globus tries to outflank an ontological compromise by saying that there is no fundamental reality of pure mental, physical, or neutral events beyond these concepts. As a result, however, the potentially interesting notion of methodological equivalence remained unspecified. On the other hand, Michael Hyland's "casual isomorphism" model

(1985) used the fourth, a strong interpretation of complementarity. Mind and brain are considered complementary descriptions of the same underlying event so that, for every instance of a causal sequence involving mental events, there is a corresponding causal sequence involving physical events. Nevertheless, such a concept seems to conform more fully to a parallelism account. Since in psychology there is nothing remotely like the wave-versus-particle findings on the nature of light, Joseph Rychlak (1993) considers the Copenhagen Interpretation not directly applicable to the mind–body problem. He would accept a complementarity principle only in the third sense outlined above by pointing out that there are four theoretical grounds of mind and behavior research (the physical, biological, social, and linguistic frames) from which distinct theories have been launched. Indeed, if complementarity were taken to be mainly the methodological principle that different experimental arrangements provide different information about the same object (Folse, 1989), its *prima facie* application to the mind–body problem would be in the restricted epistemological sense that psychological and neurophysiological approaches yield complementary information about a single event. There is no ontological compromise concerning the nature of the event.

One interesting question arises from Rychlak's and Folse's analyses: would a plausible integration of all those theories and points of view constitute the solution of the mind–body problem in a sense similar to that in which a Grand Unified Theory integrating quantum mechanics, relativity, and electromagnetic theories is considered by some (see Taubes, 1996) to be the possible final model in theoretical physics (and perhaps in matter metaphysics)? The answer is negative: successful integration of theories (such as the merging of evolutionary Darwinism and molecular genetics) certainly constitutes methodological and conceptual leaps, but does not necessarily resolve the metaphysical core of the matter. For example, in the case of evolution the aforementioned merging did not settle the ontological problems concerning the nature, trend, and design of the evolutionary process.

Bohm (1986) arrives at a dual aspect theory with his causal and non-local hidden variable interpretation of quantum mechanics according to which the wave function constitutes a type of information content whose "meaning" is in the "dance" pattern of subatomic particles. In a more elaborate rendition, conscious meaning would be the type of activity to which a given structure of information may give rise, and this activity would be both mental and physical in nature. Thus, the key concept in Bohm's interpretation is the idea of an implicate (or implicit) order underlying an explicate (or explicit) order. The implicate order would be basically dynamic in nature, and Bohm calls it the *holomovement*. The holomovement is an undivided whole that unfolds while certain aspects of it come into relief and rise to our attention. The mind–body application of this theory takes a definitive Spinozan shape: neurophysiological and conscious processes would be explicate or apparent manifestations of such an implicate order.

The neurophysiologist Karl Pribram (1986) regards his holographic (later *holonomic*) theory of brain–mind relationship as being akin to Bohm's in that multiple manifestations arise from separate realizations of a common structure that is neutrally described in information-processing terms that cannot readily be charac-

terized as either material or mental. Pribram claims that he has taken dual aspect a step further by proposing that each aspect not only is characterized linguistically but is considered a "realization" or "embodiment." In reference to the nature of the fundamental process Pribram explicitly states that "multiple realizations imply a neutral monism in which the neutral essence, the potential for realization, is *energy*" (p. 515, my emphasis). In an ontologically related vein, some of the advocates of a quantum explanation of consciousness propose that the common sources of consciousness and matter are quantum phenomena such as a particular set of eigenvalues in Hilbert space subsystems (Lockwood, 1989), Bose–Einstein condensates (Zohar, 1990), or the quantum mechanical wave function (Snyder, 1995). Recently, the philosopher David Chalmers (1996; see also Horgan, 1994) espoused a dual aspect solution concerning the nature of consciousness and referred to the underlying process giving rise to both mental and physical processes plainly as "information," an idea that has also appealed to scholars trying to establish grounds of encounter between science and mysticism (MacDonald, 1994).

Despite the suggestive elements in all of these conceptions, the ontological problem remains, for the most part, unsolved. The attractive but slippery concepts of "holomovement," "energy," or "information" are not sufficient to explain both the form and the substance of the underlying order from which the physical and mental realizations emerge. These proposals need to be spelled out further by the identification of particular psychobiological mechanisms, such as the controversial appeal to neuronal microtubules in a quantum-coherence theory of consciousness (Hameroff & Penrose, 1996). Nevertheless, the quantum-informational formulations lack a theory concerning how this notion can explain conscious phenomena, as some of the supporters of the quantum theories of consciousness themselves seem to require (Penrose, 1989). It is true that in identity, supervenience and emergence theories the absolutely crucial "how" question also remains unanswered and that some of the logical and causal explanations seem to work better in the case of dual aspect. It is precisely in reference to these and other such difficulties that the question of establishing not only theories but putative and plausible mechanisms is so crucial.

I submit there is a viable alternative to the classic interpretation of dual aspect, and it is the following: *the mental and the physical are aspects of a patterned process*. If this is so, as I hope will be shown hereafter, the various features of mind, brain, or behavior can receive a proper characterization. Consciousness, for example, can be treated both as a phenomenological process as revealed by first person reports and as functional inter-modular activity of the brain.

A mutual constraint between dual aspect and emergence: the individuality principle

High-level organic process involve a holistic and hierarchic organization of multiple levels (Haken, 1977; Koestler & Smythies, 1969). The emergence principle states that a coordinated interaction of parts results in novel properties progressively gaining in information density and cognitive meaning, finally resulting in awareness

(Bunge, 1980; Scott, 1995; von Bertalanffy, 1949). Within this frame of reference, the nervous system can be conceived as a layered hierarchy of functions within which at least six levels of organization can be defined: molecular, cellular, intercellular, modular, organic, and *organismic*, individual or personal. The interactions between subsystems become increasingly important as the units engage in more complex modes of interaction and it is the interactive rather than the component behavior that is the critical feature to built an explanation (Bechtel & Richardson, 1992). For each one of the compositional levels, multiple aspects (i.e. architectural, electrical, informational, cognitive) may be recognized. To be coherent with the structure of such organic hierarchy, consciousness should not and indeed could not, be considered a *level*, as it occurs with emergence (Searle, 1992; Sperry, 1991) and supervenience (Horgan, 1993; Kim, 1993) theses, but the cognitive *aspect* of a particular level of neurological organization. I submit that the neural correlate of consciousness is the highest level of brain function, namely, inter-modular brain activity. Such inter-modular brain activity reaches its proper expression in the context of an active organism coping with a changing environment.

According to this formulation, dual aspect and emergence are considered to be mutually constrained. Consciousness is considered an emergent property only in the sense that it is a property that appears from the functional coupling of specialized neural elements (brain modules) and also in the sense that it is the final result of a variety of levels, each dependent upon a previous one, finally integrated into a complex hierarchic system, an organic unit, an individual. Consciousness does not constitute a level in the hierarchy of natural systems; but the cognitive and phenomenological aspect of the function of a high sub-personal level, namely, brain inter-modular dynamic patterns. In this way, psychophysical properties can meet the constraint that emergent properties can only be understood if there is a thorough grasp of the underlying structures that give rise to them (O'Connor, 1994).

Information transfer among functionally specialized brain modules or sites is arguably the highest level of brain function. Even though the term module is not used in the same sense by all authors, we may define a brain area as a specialized sector of the brain which can morphologically defined. In such sense it can be said that there are more than 400 brain areas, including cortical areas and subcortical nuclei. There is evidence that each zone is probably undertaking more than one operation and relaying the results to further areas. But the projections are restricted. Thus, of the enormous amount of possible connections among 400 sites (near 80,000) only about 2000 bundles have been recognized (Rapoport *et al.*, 1968). In this highly segregated "bus architecture" connectivity a complex flow of brain sites activation takes place integrating a non-modular theme of brain activity (Díaz, 1997). A particular case of such activity has been posed for the visual system by Zeki (1993). Even though the general rules of brain inter-module or inter-site activation are unknown, some configurations may be envisaged. For example: in a manner which resembles the flying behavior of a bird flock, the *morphodynamics* of brain inter-modular patterns may very well constitute the emergent, unbounded, hyper-complex, tetra-dimensional phenomena that, given their hierarchical com-

plexity, are able to navigate throughout the brain to access, coordinate and integrate multiple information transformation mechanisms. In this way, information is directly available for global control and it optimally meets the "global availability" requirements of the neural correlate of consciousness according to Chalmers (1998). Moreover, the concept sets the empirical objective to visualize such patterns with cinematic brain images and correlate them in real time with verbal reports of mental states.

Now, these psychophysical dynamic patterns emerge not only because of the bottom–up hierarchic organization of the brain, but also because of the top–down *organismic* character and environmental context of the information flow. Thus, when we analyze the physical mechanisms which are correlated to conscious activity it is legitimate to speak of *psychophysical mechanisms*. Such psychophysical mechanisms include the operation of systems such as the *multimodal* sensory-motor systems, i.e. the dynamic systems integrating perception and action at the level of the organism or individual. Consciousness and cognition are therefore *situated* in the context of the body, and thereby in the context of the cultural environment. The move to a social and ecological environment as an inextricable part of the context where individuals dwell is absolutely crucial to the understanding of consciousness (Strawson, 1959). Such socio-cultural nature of mind has been eloquently elaborated by several authors (Merleau-Ponty, 1942/1963; Putnam, 1975; Vygotsky & Kozulin, 1986), but has been difficult to reconcile with brain accounts of consciousness except in recent attempts to understand the brain as the control of perceptual, cognitive and motor embodied activity from an ecological perspective (Clark, 1998; Kelso, 1995). Patterned process theory provides a specific frame for such integration to take place.

Taking the alive, aware and active individual as both an ontologically "ambiguous" (subject–object) entity and as the common referent of two descriptors (one physical and the other mental) enables us to argue that the point of departure and frame of reference for consciousness analysis can and should be the *whole, alive, and behaviorally interactive individual*. This approach may help us see higher brain functions, phenomenological mental properties and behavioral actions as transformations of information relevant at the individual's level of organization. This *individuality principle* must be maintained even though we accept that consciousness arises at the highest sub-personal level because it is at the level of the whole organism and its interaction with the social and ecological environment that it operates. Now, this individuality principle, insofar as it suggests that the fundamental reality is ontologically ambiguous, seems to encounter the common challenge for all dual theories, accounting for the nature of the neutral ground.

Patterned processes: the neutral ground for matter-consciousness

In a previous paper (Díaz, 1997) I submitted that the isomorphic features of brain, consciousness and behavior patterned processes are optimally compatible with dual aspect theory in that the foundation or nature of these aspects would be a highly structured dynamic process, something that I called a patterned process. In this final section I will elaborate on this proposal.

One of the main features of complex systems is dynamic pattern behavior (Kelso *et al.*, 1988; Mainzer, 1994). Thus, cognitive (Hanlon, 1991), brain (Brown, 1991), and behavior systems (Kelso, 1995) display complex and dynamic pattern features. An important type of dynamic pattern behavior is constituted by kinetic and particularly cinematic spatiotemporal transitions of certain systems and states that can be defined by particular configurations evolving in an adaptive fashion (Grande & Rieppel, 1994; Hamilton, 1967; Harrison, 1993). In living systems, there are many processes that can be recognized as stochastic transitions of particular patterns (Fisher, 1994).

Inter-modular brain activity patterns, the processing of consciousness contents and the sequence of movements or actions that define organized behavior constitute the three patterned processes most relevant to the mind–body problem. In contrast to the fully distributed accounts of mind implied by connectionism (Horgan & Tienson, 1991), the elements in transition of these patterned processes are malleable and context-dependent elements and have a "narrative" or "cinematic" structure because of their plot-like architecture, i.e. the successive activation structure of elements. These processes are said to be patterned because they are defined by dynamic forms unfolding in a particular time-dependent behavior. Thus, semi-ordained transition probability, periodicity, combination and quality describe both the structure and activity of such dynamic systems. Elaborating from the ideas of Dretske (1981), it could be said that patterned processes can be conceived as higher-level informational processes that, due to their complex underlying structure and resulting cinematic and narrative architecture, exhibit not only informational but also semantic properties.

In a preceding paper I have suggested (Díaz, 1997) that higher brain inter-modular activities, phenomenological consciousness and organized behavioral movement can be conceived as spatiotemporal patterns of activity constituting patterned processes suitable for modeling and computational implementation in open Petri nets. A Petri net is a graphical and mathematical modeling tool used for describing and studying concurrent, distributed, parallel, non-determmisnistic and stochastic systems. It consists of *places* (which contain *tokens*), *transitions* and *arcs* that connect them. Transitions are active components that *fire* if they are *enabled* with tokens available in the input places. Such architecture is ideal to model the dynamics, activation trajectories and task-appropriate kynematics of neuro-cognitive systems. This possibility does not necessarily imply that the stuff from which mind–body processes are made is ultimately of a computational nature. It means that, because of their isomorphism, such processes are amenable to be modeled in unison, and that Petri nets constitute one such possible tool. Even though cross-domain isomorphism does not prove a fundamental identity among neural, mental, and behavioral processes, it allows for the verification of psychophysical bridge laws and it helps to fill the conceptual gap between these phenomenal aspects and their natural foundations. Thus, the nature of the fundamental reality can be said to have the dynamic, energetic, and informational features of a patterned process, and patterned process theory provides a heuristic notion of such neutral psychophysical ground.

This idea may suggest that the patterned process psychophysical ground is a mysterious and deeply hidden foundation of the apparent reality. This is not a necessary implication. The individual is not a static but a dynamic system defined by a patterned process of becoming. Such a process is the result of the moment-by-moment integration of a manifold of physiological processes organized in the hierarchy of organic systems where the three aforementioned high-level processes are signaled out as crucial in understanding the dynamics of the mind–body system, unit, or individual.

From an epistemological point of view the present patterned process approach allows for the following three claims. (1) It is sound to approach higher brain activities, phenomenological consciousness and organized behavioral actions with specific scientific methods and to develop data generating systems and models in order to correlate the signals in real time. The fact that we need physical, biological, behavioral, cognitive, or social descriptors to approach these processes does not mean that the fundamental reality is dual or multiple, but only that the methodology is plural. (2) Plural methods should not remain segregated. Intra-level and inter-aspect correlations or *concurrences* may constitute psychophysical bridge laws, a type of mind–body correlation notion devoid of the hindrances of classical reduction. (3) This approach preserves folk and scientific psychology and fosters the development of a mature science of consciousness

Patterned process theory makes the following four ontological claims. (1) The processes involved in the mind–body problem are defined by transitions of living patterns and functions. Because of their isomorphism they are defined as patterned processes where, in accord with process philosophy (Ford, 1987; Rescher, 1996), motion is considered the fundamental reality. (2) In contrast with a wide pan-experientialism implied in the theories of Spinoza and Whitehead, in patterned process theory motion is not always psychophysical in nature. Only at the highest dynamics of multi-layered organic nervous systems do mind–body patterned processes emerge that are endowed with the aspect of experience, perhaps because they are able to generate phenomenological information about themselves. (3) The psycho-neural process is said to be *dual* in a sense similar to the theory of Dirac concerning electricity and magnetism, that is: brain inter-modular dynamics are dual to consciousness only in the spatiotemporal domain. (4) It is in reference to the whole individual and its relationship to the social, cultural and ecological environment that consciousness acquires the characteristic features of meaning in action.

These claims allow for this final assertion: patterned process theory is a monist dual aspect ontology demanding a pluralistic (biological, cognitive, phenomenological, behavioral, social) methodology.

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