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Review

The mind-body problem; three equations and one solution represented by immaterial-material data

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Abstract

Human life occurs within a complex bio-psycho-social milieu, a heterogeneous system that is integrated by multiple bidirectional interrelations existing between the abstract-intangible ideas and physical-chemical support of environment. The mind is thus placed between the abstract ideas/ concepts and neurobiological brain that is further connected to environment. In other words, the mind acts as an interface between the immaterial (abstract/ intangible) data and material (biological) support. The science is unable to conceive and explain an interaction between the immaterial and material domains (to understand nature of the mind), this question generating in literature the mind-body problem.

We have published in the past a succession of articles related to the mind-body problem, in order to demonstrate the fact that this question is actually a false issue. The phenomenon of immaterial-material interaction is impossible to be explained because it never occurs, which means that there is no need to explain the immaterial-material interaction. Our mind implies only a temporal association between the immaterial data and material support, this dynamic interrelation being presented and argued here as a solution to the mind-body problem.

The limited psycho-biologic approach of the mind-body problem is expanded here to a more comprehensive and feasible bio-psycho-social perspective, generating thus three distinct (bio-psychological, bio-social, and psycho-social) equations. These three equations can be solved through a solution represented by a dynamic cerebral system (two distinct and interconnected subunits of the brain) which presumably could have the capability of receiving and processing abstract data through association (with no interaction) between immaterial and material data.

Keywords : mind-body problem, three equations, one solution, immaterial-material data, bio-psychological, bio-social, psycho-social, internal mental interaction

Highlights

- ✓ Interaction between immaterial data and material brain is not possible, the mind body problem referring rather to procession of immaterial data by our material brain.
- ✓ Procession of abstract data by our brain is possible through association between immaterial data and material/nervous impulses of the brain, interface of this association being represented by time

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Introduction

The mind governs to a great extent both one's physical existence and psycho-social life, having a psychological self/ identity that is distinct from the physical body, and a conscious reality (colors, sounds, etc.) that differs from the surrounding physical and chemical external reality (electromagnetic waves, air vibration, chemical compounds, etc.) (1, 2).

Beyond the individual psychological existence, a society is based on the persistent social participation and interaction of its individual members, thus affords to its members benefits that would not otherwise be possible. Such benefits can be in the form of individual and/ or common benefits, and refer to various (abstract or concrete) kinds of advantages that result from social exchanges (e.g., learning, cultural traditions, playing games like chess, etc.). A society is thus characterized by patterns of relationships (in the form of social relations) between individuals who share a distinctive culture and personality. Accordingly, a given society can be described as the sum of the existing relationships of its constituent members. A large society may exhibit stratification or dominance patterns among subgroups, which usually become evident during mental interactions among its members (3, 4).

Thus, the individual is part of the society, governed by its norms and values, but who at the same time must integrate within the larger prevailing social system. If the individual contributes to societal goals, that society in turn contributes to the individual's mental development. In support of this idea, social medium, for example, is critical for evolution and development of the mind, either through a positive involvement in education and learning or, alternatively, by limiting/ counterproductive factors (social restrictions, social competition and exclusion, irrational mentalities, etc.).

Human beings are therefore complex bio-psycho-social entities that represent the end-product of interactions among biological (genetic, neural, biochemical, etc), psychological (personality, mood, behaviour, etc.) and sociocultural (school, socioeconomic tasks, cultural medium, religious norms/ beliefs, etc.) factors (5).

Contrary to this integrated bio-psycho-social perspective, literature data is still dissociated by restricted interpretations and results. For example, the psychological identity is presented in a didactic way in relation with self-image (the view you have of yourself), self-esteem (how much value you place on yourself), and individuality. It is unclear to what extent the self-components would be supported by the brain, or they

would be in fact just analytical interpretation/ products of the mind (6). At opposite end, mental impairments like autism or attention deficit hyperactivity disorder would result (according to imagistic studies) due to functional disruption of several brain networks (7-9).

As a consequence, it would be insufficient to study mental entities and events from restricted (either psychological or biological) perspectives. For this reason, there are papers presenting new psychophysiological approaches, with psychological phenomena (such as internal mental interaction) resulting from cerebral interaction between distinct subunits of the brain. In this paper, we elaborate upon this concept of internal mental interaction from a unified bio-psycho-social perspective for humans, a conceptualization which might further represent a solution to the mind-body problem.

Discussion

From a physiologic perspective, environmental interaction (between external stimuli and the body) ends at the level of primary somatosensory cortex. According to indirect realism, data from primary somatosensory cortex is further projected within the brain (to secondary somatosensory cortex) creating a veritable internal-mental copy of the environment (10). Recent papers sustain that concepts like indirect realism, the self and identity should be revised, not only in respect to the level of organization and deployment (psychological versus bio-psycho-social), but also regarding the role and interrelations of the respective entities and events (11).

Thus, a relatively new theory sustains that the mind would be comprised of two distinct and complementary subunits of the brain, represented by "internal mental existence" and "internal mental reality", interacting with one another in the form of "internal mental interaction" (Figure 1). As a consequence, entire environmental interaction would be actually projected and reproduced within the brain, environmental stimuli being projected as internal mental reality (supported by the somatic nervous system) while the body would be projected as internal mental existence (supported by autonomic nervous system). Accordingly, internal mental existence and internal mental reality would be supported by specific/ dedicated neurological structures of the brain, which transmit mental data from one to the other (12).

From a functional point of view, the deployment of internal mental interaction would be independently by environmental interaction, these two/ parallel interactions being interconnected just informationally. This functional disconnection would be able to explain

the autonomy of the mind in respect to environment (focusing attention on internal ideas/ representations while ignoring external stimuli, dreams, imagination, etc.), the fact that the mind works with internal stimuli and elaborates internal responses (without a mandatory externalization), and some pathological situations like autism spectrum disorder.

Corresponding to the physical body, internal mental existence possesses on one hand the attentional focus to receive afferents (inputs), and on the other the decision-making process to elaborate responses (to release outputs). The appurtenance of decision making processes and attentional focus to the same neuro-informational entity of the brain (internal mental existence) is able to explain the close connection existing between these two processes. Sometimes our decisions originate from our attentional focus, while other times we first decide what to do and subsequently direct our attentional focus towards objects/ people that support the performing of the established target/ desire. But, in handling abstract data, our autonomic system supporting internal mental existence is not able to interact with classical neurophysiological processes of

the brain. As a consequence, both attentional focus and decision-making processes imply intervention of a specific interface (internal mental reality), to ensure conversion of information between the mental (abstract) format and the neurophysiologic format (of the body), conversion that represents the core subject of the mind-body problem (11).

Literature conceptualization on this topic focuses on two distinct notions: indirect realism and the psychology of self. Indirect realism is viewed as an internal projection of external data (10), while psychology of self discusses about the self as “I” (the subjective knower) and also the self as “Me” (the object that is known) (13). According to our interpretation, the old concept of internal mental representation should be extended to a larger approach like internal mental reality, because it is dual performing not only inputs but also outputs. The old concept of self should be also revised, the self as “I” corresponding to a real neurologic-informational existence (internal mental existence), while the self as “Me” would correspond to circulating mental data that is related to our own conscious representation (mental identity).

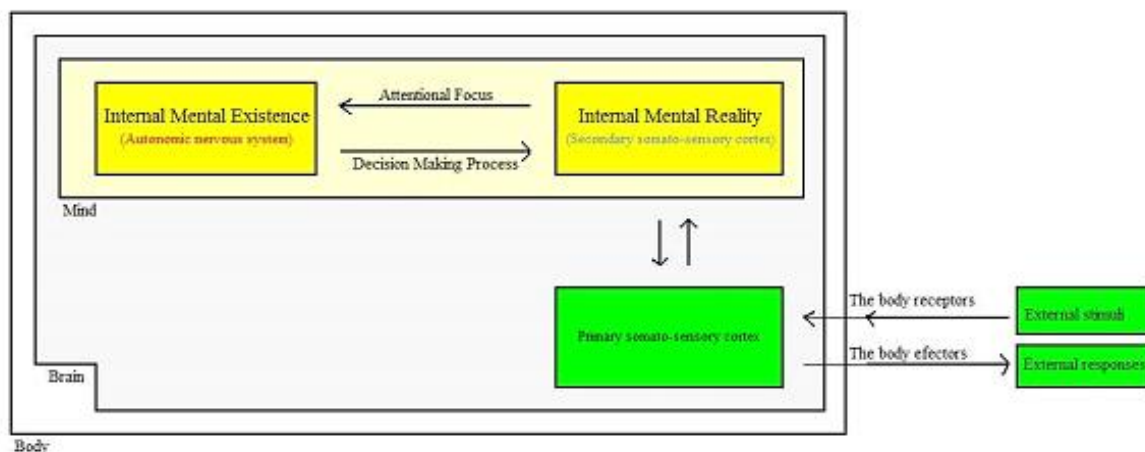


Figure 1. Internal Mental Interaction (yellow) and Environmental Interaction (green)

1. Psychological existence and the corresponding cerebral support; internal mental existence

Although the mind incorporates an abstract dimension, it has good connection and control over the physical body. Thus, the mind is able to focus attention on external physical stimuli (facilitating their entry to the conscious domain through peripheral receptors) or can elaborate (through conscious and voluntary decision making) and transmit to the brain/ skeletal muscles unlimited abstract motor responses. Such abstract efferents are represented by gestures, motor participation of the hands to support abstract verbal explanations (e.g., arranging in virtual-imaginative

space abstract entities, like a company and interrelated profit and loss), dances in different styles, and so on (1, 14, 15).

In turn, the human body sustains the mind directly through cerebral activation and response and indirectly through supporting physiological (metabolic, endocrine, respiratory, circulatory) mechanisms. As an example, mental existence ceases when the neurophysiological processing of the brain is interrupted through procedures such as hypnosis or general anesthesia, and when the brain is damaged or the physical body dies (16, 17). Moreover, intensive abstract exercises can tire the mind, with increased need for sleep after a period of intense

mental concentration/ activity (18). Yet, studies using fMRI have shown a direct connection between some psychological performances (attention, concentration, analytical analyze, etc.) and specific cerebral areas. Several drugs acting within the brain keep us awake (caffeine), and/ or improve our attentional focus (atomoxetine) and mental power (19, 20).

Even if there is a close connection between the mind and physical body, the mind implies a specific (intrinsic/autonomic) presence, which was described not only during attention-demanding tasks but also when an individual is awake and at rest (wakeful rest). Attention-demanding tasks seem to be supported by task positive network of the brain, while mental presence during wakeful rest appears to be sustained by default mode network of the brain (7, 8). The psychological presence (as psychological event) and the corresponding neurological support generate together internal mental existence, which is different by the physical existence of the body so that it can be compatible with analytical attention and decisions (Figure 2).

In support of internal mental existence, our mind is

$$1. \text{ Mental Entity} + \text{Body} = \textit{Individual / personalized Mental Existence}$$

2. Conscious representation of social data in the form of mental reality

The mind occupies a position “over” the individual (physical and psychological) existence, due to the fact that it is able to establish connections not only with the physical body but also with abstract-intangible data (playing chess for example, abstract conversations to math lessons, etc). For this reason conscious representations extend beyond the individual existence, preoccupations like learning, exploration and documentation implying a strong social-relational participation (23). The exchange of abstract ideas between individuals (e.g., through verbal and written communication) is an essential process for acquiring knowledge and for subsequent cognition (24). Accordingly, mental reality overlaps to a great extent with the surrounding social-relational medium, a proposition that can explain not only the extension of the mental reality beyond the physical body, but also the mind’s capacity for awareness of social events and data (Figure 2).

Based on such mental interactions among individuals, social psychology studies the influences exercised by some individuals on the thoughts, feelings, and behaviors of others (25). Such interpersonal influences induce specific mental phenomena and

able for example to disconnect from environmental/ social data (ignoring external physical stimuli) and focus attention on internal abstract ideas, impressions and cogitations (using memory, imagination, thinking, etc.) (1). Due to this autonomous and analytical functioning, long-term abstract preoccupations (improvement of one’s reputation, developmental professional strategies, etc.) are sometimes more important for decision making process than the short-term concrete needs of the physiological body (eating, sleeping, etc.). Such developmental strategies/ desires (generally abstract in nature) are often hidden within our minds from other members of society (who can oppose them, due to a real competition on food, houses, jobs, privileges, etc.), having thus a strong personal character (21, 22).

As a conclusion, the mind implies a well delineated psychological existence, which are supported by the brain but functionally disconnected (at least in part) from the physiological-environmental existence. In psychological and biological terms, the first (psycho-biologic) equation of the mind-body problem is as below (see Figure 1):

experiences like attitude, persuasion, social/ political influences, social cognition, etc. From a physiological perspective, the environment represents an external medium for the biological body; from the perspective of social psychology, the surrounding social medium is an intrinsic part of our mind, in the form of mental (psycho-social) reality (26).

This mental (psycho-social) reality is placed to disposition/ discretion of our mind for cognition, which is able to voluntarily scan the entire conscious reality (abstract job tasks, the arrangement of environmental objects, the requests of social partners, etc.) through one’s attentional focus, selecting through decision making processes a certain element or task to be studied/ performed while ignoring the others. In this way, abstract social tasks sometimes take higher precedence in the mind than specific individual needs and pleasures (27). Mental reality/ representation incorporates therefore not only individual mental elements (perceptions, feelings, beliefs, identity, etc.) but also a social-relational dimension (often abstract/ informational in nature), being entirely realized and processed by our mind. In psychological and social terms, the second (psycho-social) equation of the mind-body problem would be as below (see Figure 2):

$$2. \text{ Mental Identity} + \text{Abstract Social Data} = \text{Psycho-Social Reality}$$

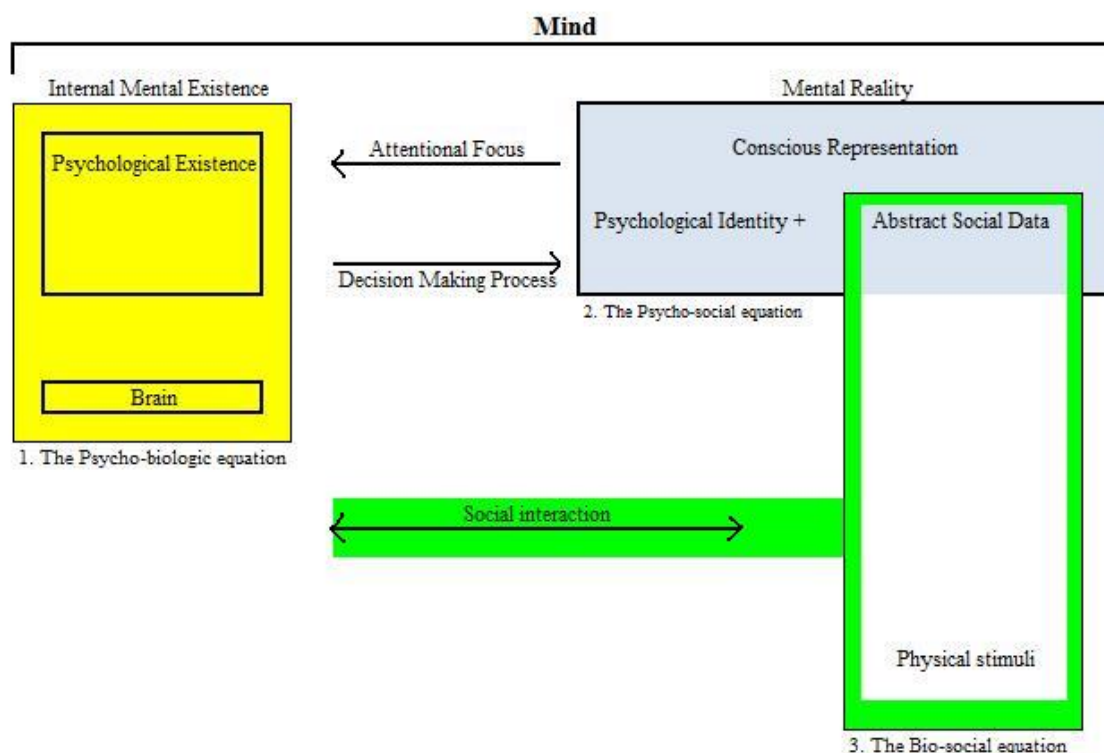


Figure 2. The psycho-biologic (yellow), psycho-social (blue) and bio-social (green) interpretations

3. *Bio-social transmission of abstract social data*

Social interaction within social systems implies usually two (or more) individuals exchanging abstract and concrete data between them. Thus, two separate individuals are able to transmit abstract ideas between them, resorting usually to language to communicate (28, 29). On one hand, environmental social data are abstract-immaterial, so that such data are unable to interact with the physical-material body and brain. On the other hand, transmission of abstract data between two individuals clearly occurs, being possible through somatic peripheral effectors (mouth) and receptors (ears) of the body. Such transmission of abstract-immaterial data between two physical bodies is possible through the annexation of abstract data to external physical stimuli, the latter being able to interact with physical receptors of the body (1, 30).

Thus, abstract data is transmitted between two distinct persons (physical bodies) via a physical environmental stimulus, which is capable of encoding an abstract message. For example, a sound is a physical stimulus (received by ears) which can encode (in the form of a word) an abstract message ('come'). Light is another physical stimulus (received by eyes) that can encode (in the form of Morse code) the same abstract message ('come'). Signs, gestures, and written language are also received by eyes as visual stimuli, yet all these stimuli can encode the same abstract message ('come').

These examples indicate that an abstract/ immaterial message can be attached to a physical stimulus, yet are separate from the material properties of the respective physical stimulus (you can say 'come' aloud, or slowly, or with certain tonal qualities: inviting vs demanding) (31, 32).

As a conclusion, abstract social data are immaterial messages that are never self-standing, so that it must be attached to external physical stimuli. Three distinct remarks are warranted here.

The first observation is that the described attachment of abstract data to material stimuli makes sense only when it is transmitted between two distinct entities (because it incorporates a message), and when the two entities use the same encoding-decoding procedure/ language (the receiver person must be able to extract the abstract message carried by the physical stimulus. As an example, while one person might understand the meaning of a certain word in his/her native language, another who does not know that language would not understand the message (the word has no significance) (12, 22).

The second is that the attachment of abstract data to a physical stimulus is a dynamic association, established between an abstract message and succession in time of several physical stimuli (light signals for Morse code, letters in words, etc.). This dynamic association is therefore possible through time, which is related to both

physical matter (being physically measurable) and to abstract data (which is non-material) (1). Abstract immaterial data can therefore be associated in dynamics (in time) with several successive physical stimuli, but with no direct connection or interaction with the physical stimuli because abstract immaterial data and physical stimuli are distinct in nature.

The third remark is that abstract-immaterial data are associated in time with physical stimuli, so that abstract-immaterial data and properties of physical stimuli

(as material data) can be associated/ interrelated (which does not mean they interact), generating together through emergentism a new entity, in the form of immaterial-material data.

Immaterial-material information should, therefore, be able to exhibit new properties, which would have no meaning in a limited bio-social approach, because these new properties should emerge over/ above the level of material-immaterial organization and interpretation (1) (Figure 3).

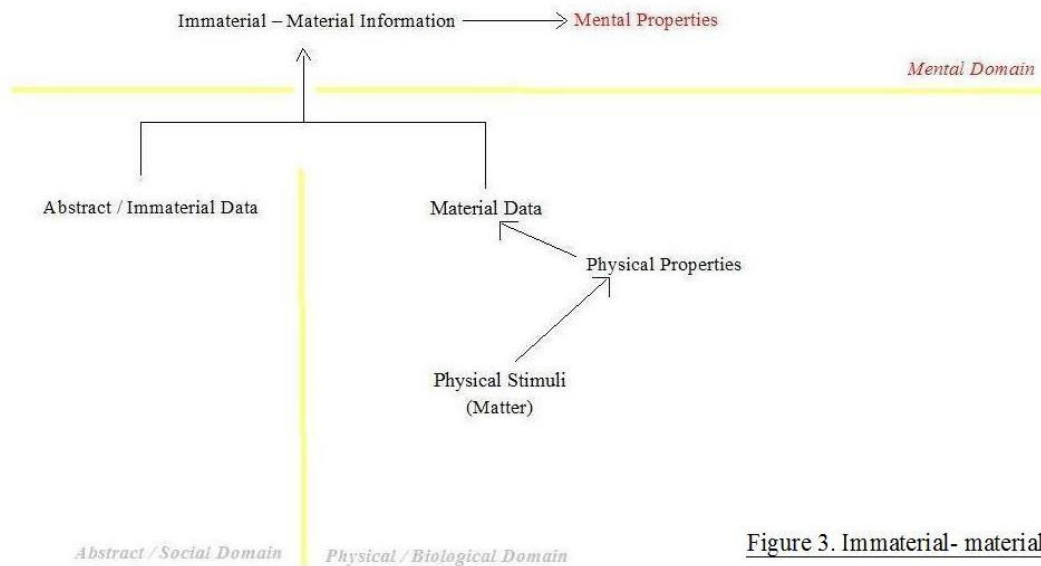


Figure 3. Immaterial- material information

As an example, in a psychological interpretation, when intensity of the sound adds to an abstract message, the resulted material-immaterial information exhibits mental properties which can be received by a person/ mind in the form of emotional messages like anger (e.g., when saying `go` screaming), endearing/ affectionate (when saying `come` whispering/ delicate), etc (33). Being compatible with our mind, the material-immaterial information (supported by physical stimuli)

is therefore mental in nature. In turn, the mind should present a similar organization, consisting of a physical support (the brain) and the corresponding material-immaterial information, a supra-physiologic system that emerges over the level of material-immaterial representation and interpretation (1, 34).

In biological and abstract-social terms, the third (bio-social) equation of the mind-body problem would be:

$$3. \text{ Physical stimuli + Abstract-Social Data = Social interaction = Transfer of abstract data between two physical bodies/ entities}$$

4. A bio-psycho-social integration

The three perspectives presented above (psycho-biologic, psycho-social and bio-social) must merge into a unitary bio-psycho-social model, with such a unified model being specific for humans (35). In support of this, we are for example conscious about psycho-social reality not only during interaction with social medium (as a result of social activity), but also at the individual level (as a result of cerebral activity). Thus, the conscious social reality can be contemplated/ studied by

an individual through imagination, memory, or dreaming (36, 37).

To arrive at this unitary model, it is necessary to transfer and implement inside of a single brain the psycho-social reality, due to three important reasons: a) we are aware of the psycho-social reality, b) conscious reality has a strong individual appurtenance, and c) social cognition/ abstract events are strongly related to specific cerebral areas of the brain (3, 12, 24, 26, 27, 30). In this way it is actually generated a personal/individual

and supra-physiologic (material-immaterial) mental reality, closely related to the individual mental state described by commonsense psychology. Being individualized, a person can resort to his/her own mental state and experience to explain and predict the behaviors and mental states of other people in a wide range of circumstances. Being supra-physiologic, the mental state is able to explain specific mental processes (like pain, pleasure, excitement, anxiety, envy, pride, empathy, etc) and, in addition, to interact with abstract/mental data (38, 39).

The most feasible way to transfer/ create a conscious social reality within a single brain is to copy

the entire social model within the respective brain. According to the social model, abstract social reality is an incontestable event and results from two distinct persons exchanging abstract messages between them. In a similar way, two distinct neuronal subunits of a brain (internal mental reality and existence) should be capable of exchanging abstract messages (or, more precisely, material-immaterial information) between them, creating/ supporting within the respective brain a supra-physiologic internal mental interaction (1, 40).

This assumption of a “dual” brain can be verified resorting to the three equations of the mind-body problem.

Mind = Individual Mental Existence	+	Psycho-Social Reality
Mind = Mental Entity + Body	+	Mental Identity + Abstract Social Data
Mind = Mental Entity + Mental Identity	+	Physical support + Abstract Social Data
Mind = Conscious Existence and Representation	+	Transfer of abstract data between two physical entities (subunits of the brain)

From a physiological perspective, the two distinct neuronal subunits of the brain could be represented by somatic and autonomic nervous sub-systems. The somatic nervous system (SNS) ensures the relational connection of the body with the external medium (a physical/ chemical reality: electromagnetic waves, acids, bases, etc.), which is projected within the brain as an internal mental reality (colours, tastes, smells, etc.). The autonomic nervous system (ANS) would support the mental entity, which analytically processes mental data received (through attentional focus) from the internal mental reality.

The involvement of the ANS in the construction of the mind could explain the mind’s capacity to work with internal stimuli instead of external stimuli (e.g., colours, sounds exist only in our mind), to elaborate internal responses (with no mandatory external transmission), and to support environmentally-independent autonomous functioning (imagination, dreams, etc.) (40-42). This autonomous functioning could explain an individual’s mental capacity to disconnect attention from environmental/ social data (ignoring external physical stimuli) in favor of internal abstract ideas/ impressions (cogitation).

5. *Consciousness within a supra-physiologic interpretation*

When the mind processes any kind of (abstract or concrete) data, the physiological mechanisms supporting procession are the same, but the responses are different according to the type of information that is processed. The mind is therefore able to access and process distinct information in distinct sessions (mathematics, cultural, related to its own self, etc.), somewhat similar to a computer that can run (on the same hardware support) distinct software applications in distinct sessions (as seen in computational neurosciences). Such mental processing can be performed individually, or in the form of social communication and learning (43, 44).

The SNS ensures the relational connection of the body with external medium and internal mental reality, while the ANS supports mental entity/decision and attentional focus. But the mental data are dynamic (material-immaterial data must be circulated bi-directionally), and the mind has a consciousness. To explain these characteristics, it has been suggested that the ANS receives nervous impulses from the SNS, ensures processing of the information received/ associated in an analytical manner, and the results are sent back towards the SNS. The process described

continues indefinitely (with the same or other data), resulting in a bidirectional and continuous circuit for mental data, which must flow/ be dynamic (1, 45, 46) (Figure 1).

In psychological terms, our mental presence is able to select and receive (through voluntary attentional focus) data from the internal mental reality, to consider it in an analytical manner, and return the outcome (involuntarily) back to the internal mental reality. This circuit resumes so that the individual is notified through attentional focus about the action (decision making process), about a specific object (that was taken into consideration), or about our mental entity (as a subject of our attention). This is the consciousness (qualia)—the state/ quality that enables the “somebody” (ANS) to be aware (informed) of the “something” (SNS)—within a continuous feed-back loop that keeps us conscious and awake (1). Even if the circulating data are similar along the two directions, only the direction from internal mental reality/ something (the SNS) towards mental identity (ANS) represents consciousness, as attentional focus. The opposite direction does not engender consciousness, due to the fact that the “something” can’t be aware about the “somebody” (1, 22).

The mind has thus a conscious domain and an unconscious part. Physiologically, for example, the body is unable to ingest external visual stimuli, because external stimuli belong to the environment. An electromagnetic field (the physical format of external visual stimulus), for example, terminates at the level/ contact with cone cells of the eye. From this point forward, the qualitative and quantitative properties of the external visual stimulus are transformed in a physiologic format (nervous impulse) and transmitted to the primary somatosensory cortex. Thus, the primary somatosensory cortex has no access to the external (physical/ chemical) format of environmental information (45). In a similar way, our mind has no access to the physiologic format of information, because the mind is organized above this level of representation. In other words, attentional focus is unable to identify the neurological support of the surrounding internal mental reality (our mental existence is unable to be conscious about neurological component of the mind), because the mind and consciousness emerges at a supra-physiologic level. It is a consequence of the fact that internal mental existence is designed to only receive specific data (in a mental format) from internal mental reality (1, 46).

Conclusions

The mind-body problem refers to the existing interrelation between the abstract mind and the material body. This paper continues a series of articles on this topic, suggesting that the physical matter (body and brain) is not able to interact with abstract data, but can however receive and process such abstract data. Transmission of abstract data to a person is possible through association between immaterial and material data, an association that is performed in time and as a dynamic attachment (1). Even an ordinary word for example encodes abstract data through several letters/ sounds produced over time.

The abstract dimension of the mind is a dynamic process within the brain even during sleep, and thus is able to explain the occurrence of dreams. When this dynamic process is terminated (for example, a cerebral hypoxia, for only 4-8 minutes), the abstract dimension of the mind ceases permanently. In such a case the brain may still be able to produce an arousal state, but one without awareness (consciousness and mental identity are permanently lost, or severe impaired), a condition described in the literature as persistent vegetative state (47).

Finally, the mind is not a simple neuro-informational entity. Rather, it is a system composed of two distinct and interconnected neuro-informational entities, using the same language for encoding-decoding data. The consequence of data transfer (between SNS and ANS) is not a summing effect of the two neuro-informational entities, because these two structures (having distinct/ complementary roles) present actually synergistic actions (and have no sense if one is isolated/ studied separately from the other) (1). While some cerebral structures support internal mental reality (colors for example), other structures are involved in experiential sense of self (continuity of 'I' experience), according to imagistic studies (21, 47, 48). Accordingly, the SNS and ANS together create through emergentism a complex neuro-informational entity which is able to support a dynamic processing and representation of mental substance (as immaterial-material nature) of the mind (1, 40). New studies will be necessary to further develop the concept of immaterial-material association, as previously described through fMRI studies (for example, for visuo-haptic convergence) (49, 50), or to

explain multiple interrelations existing between the mind, autonomic nervous system and sexuality (51-53).

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