

Chapter 3. Mental Physics

The 18th century German philosopher Immanuel Kant made a “Copernican turn” from an ontologically centered philosophy to epistemologically centered one. Kant’s works [see citations] were laid out and expanded in the 2500 paged, *The Critical Philosophy and the Phenomenon of Mind* [Wells, 2006]. CPPM is the abbreviation for this book.

CPPM is a theory of fundamental principles and laws of mind, beginning with observable phenomena and progressing down to the underlying principles for understanding phenomena. This approach is consistent with Francis Bacon’s investigative method,

“There are and can exist but two ways of investigating and discovering truth. The one hurries on rapidly from the senses and particulars to the most general axioms, and from them, as principles and their supposed indisputable truth, derives and discovers the intermediate axioms. This is the way now in use. The other constructs its axioms from the sense and particulars, by ascending continually and gradually, till it finally arrives at the most general axioms, which is the true but unattempted way”. [Bacon, 1620]

Mental physics as coined by Wells is defined as the application of these principles to the study of mind and brain [Wells, 2009]. This work was presented in the *Principle of Mental Physics or PMP* [Wells, 2009].

It is not the objective of this chapter to go through every detail of mental physics (cf. above) but to provide a few principles or concepts that help understand the problem of comparison mentioned in the earlier chapter. To differentiate technical terminologies from ordinary English words they will be in bold texts with or without other highlights.

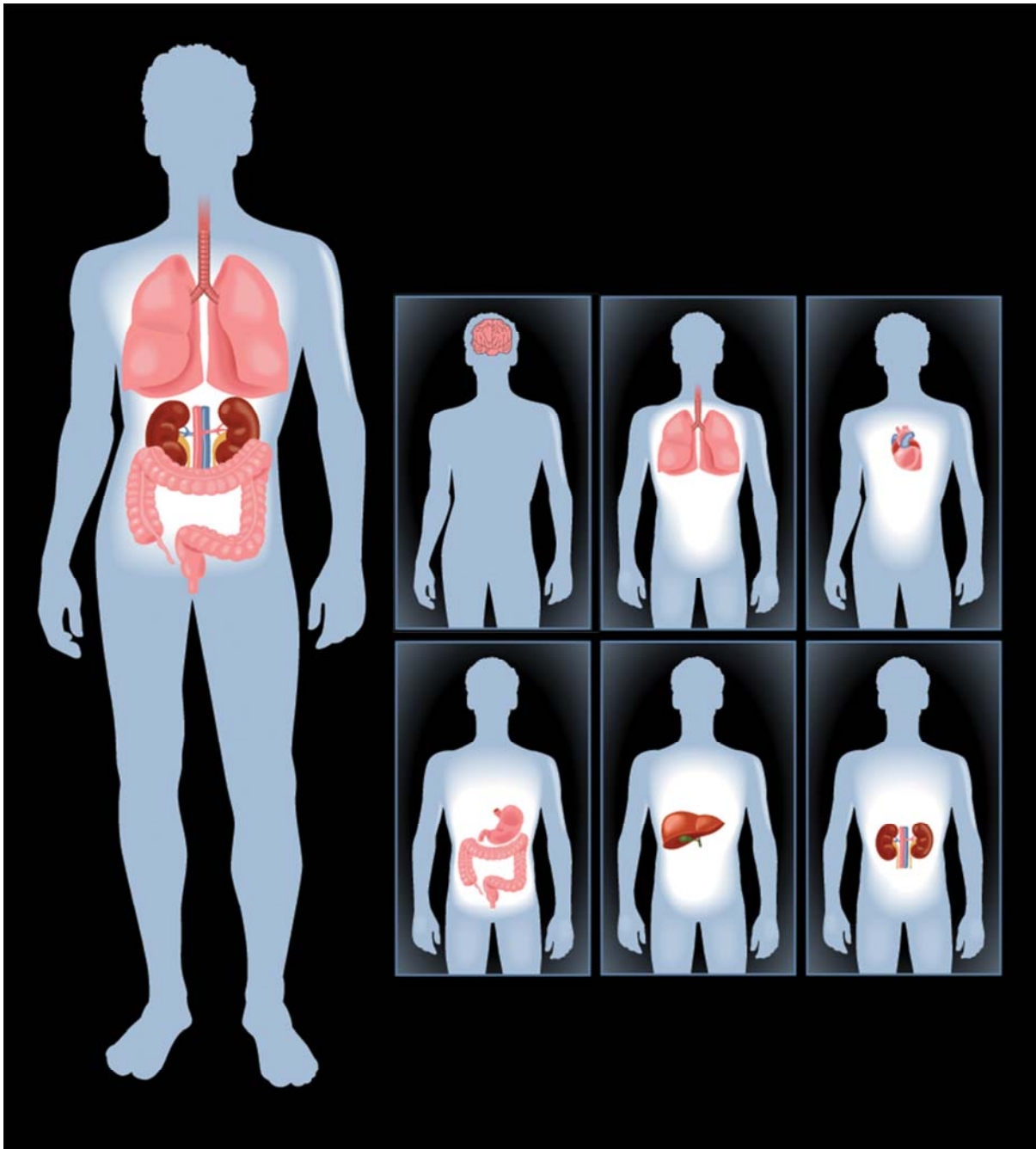


Figure 3.1. **Logical division** of human physiology as systems. Central nervous system, respiratory system, cardiovascular system, gastrointestinal system, hepato-biliary system and renal system.

Logical vs. Real division

Logical division (LD) is technically defined as,

“a disjunctive anasynthesis in which the determinant judgment of the coordinate concepts carries the Modality of possibility” [Wells, 2009 Glossary]

and the **real division (RD)** is defined as,

“a disjunctive anasynthesis in which the determinant judgment of the coordinate concepts carries the Modality of actuality”. [Wells, 2009 Glossary]

For practical application of the definition, what do they mean? For analysis and hence understanding a thing or concept, if we divide it such that the parts are possible then the division is LD but if the parts are actual then it is RD. Thus, LD is an epistemological division while RD an ontological division.

In most medical-physiology textbooks the human body is divided as systems: central nervous system, respiratory system, cardiovascular system, etcetera (Fig.3.1). But in actuality (function) they are not independent. For instance, the heart does not function independent of the lungs, hormones, nerves, etc. Thus, this is a LD. On the other hand, a man and his car are actually separate (Fig.3.2). Hence this a RD.



Figure 3.2. Logical versus Real division. (a) The man and his theoretical silhouette is a logical division because the latter is only a representation of the former. However (b) the man and the car is a real division.

Descartes' error and why Mind-Body division is a logical division

René Descartes' most famous statement was,

in French “Je pense donc je suis” [Descarte, 1637],

in Latin “Cogito ergo sum” [Descarte, 1644],

which in English translates as “I think therefore I am”. Descarte considered thinking as a separate activity from the body. Thus, he regarded *res cogitans* or ‘thinking thing’ as ontologically separate from *res extensa* or ‘extended substance’ (causative mechanical parts). Mental physics considers them not to be ontologically separate. However, Descartes' view has pervaded both popular culture and academia.

The result is to this day brain is taught in terms of “specific brain region for respective function” (Fig.3.3). With the evolution of computing power and motivation to build the ‘electronic-brain’ people working in the field of artificial-intelligence, most notably Marvin Minsky [Minsky, 1986], have developed the notion of brain as the hardware analogue while mind is the software analogue (popularly termed wetware with the prefix ‘wet’ referring to the living tissue of the brain).

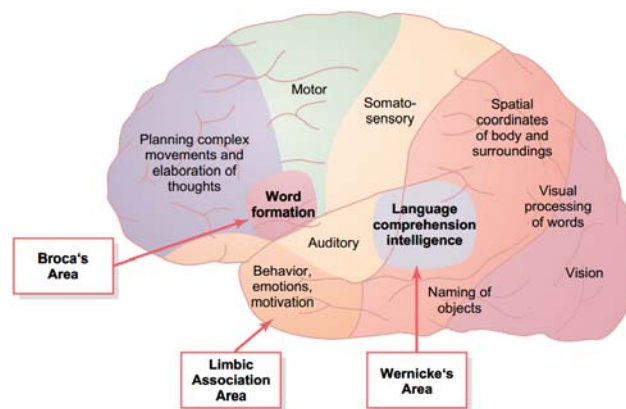


Figure 3.3. Map of specific functional areas in the cerebral cortex as taught in medical physiology textbooks [Guyton, 2006].



Figure 3.4. Mind and body as two sides of the same coin.

Experimental evidences have proven that this separation is not real in the *context* of experience. Therefore, Descartes' *res extensa* and *res cogitans* or body-mind division is a LD.

In other words, body and mind are like two sides of the same coin (Fig.3.4). This term

Descartes' error was coined by Antonio R. Damasio, which he describes as,

“This is Descartes' error: the abyssal separation between body and mind, between the sizable, dimensioned, mechanically operated, infinitely divisible body stuff, on the one hand, and the sizable undimensioned, un-pushpullable, nondivisible mind stuff; the suggestion that reasoning, and moral judgment, and the suffering that comes from physical pain or emotional upheaval might exist separately from the body. Specifically: the separation of the most refined operations of mind from the structure and operation of a biological organism”. [Damasio, 1994]

Organized being (OB)

Let us call the model of the subject whose phenomenon of mind we are interested in studying, **organized being (OB)**. OB is that in which ‘concepts of everything we think about it is united’. The adjective comes from the verb **organization** as shown in figure 3.5, where

concepts are combined by synthesis and given structure and function. This avoids Descartes' error. A natural follow up question then is how to regard the existence of OB.

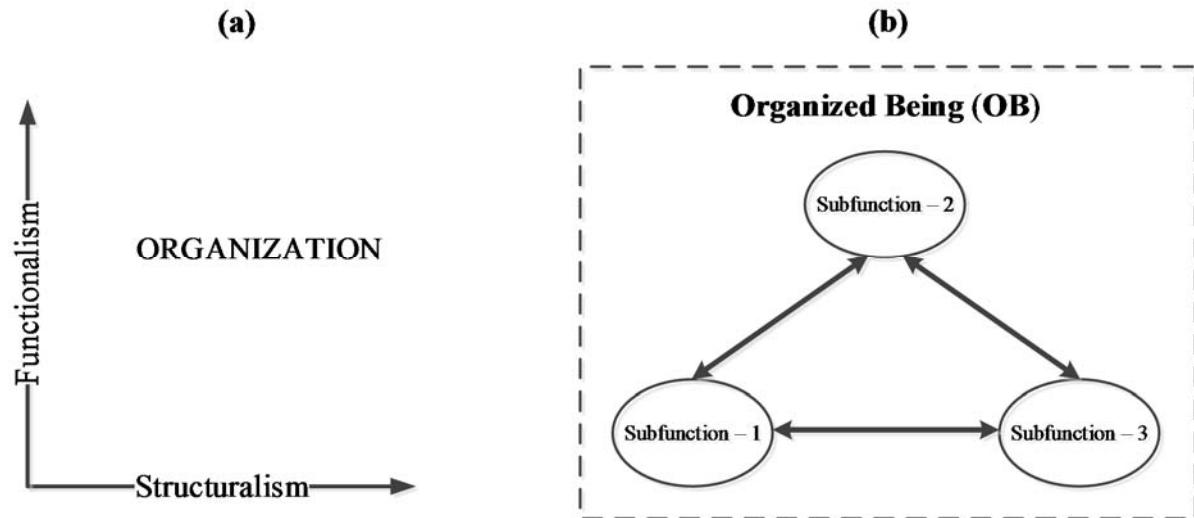


Figure 3.5.(a) Coordinate concepts of organization. (b) Illustration of idea of functional totality in an OB.

The knowledge of existence has two components, one that answers the question “what exists?” and another “how does it exists?” The former is called **Dasein** and latter **Existenz** (Fig.3.6). Thus before saying anything about ‘it’ we must first judge that ‘it’ exists in the context of having Dasein. A proposition of Dasein states nothing more than that some transcendental **Object** exists as the logical subject in other propositions that describe its Existenz, i.e., “how it exists”. The transcendental Object is said to be the **matter** for Existenz propositions. The latter propositions are collectively said to constitute its **form**.

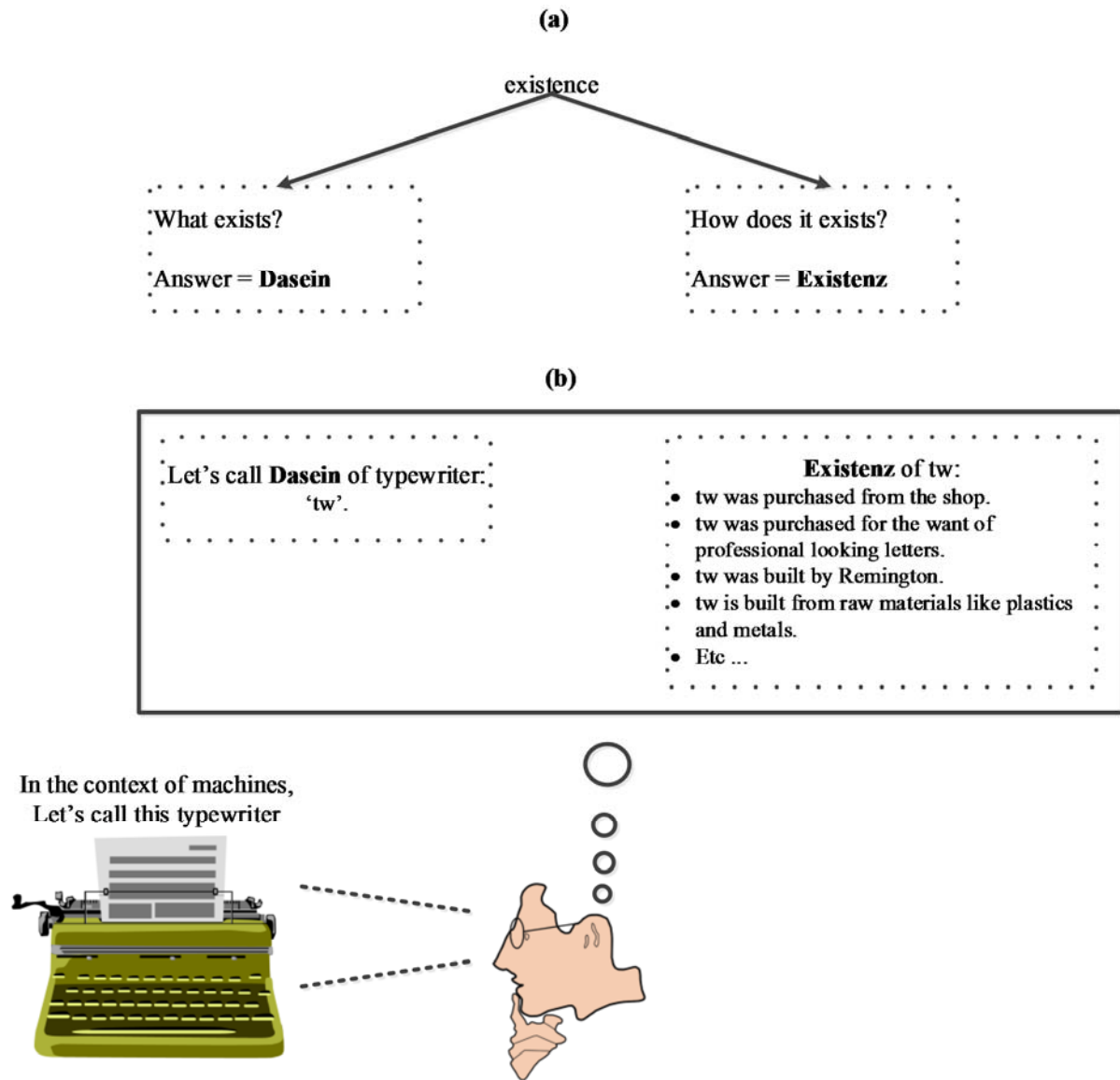
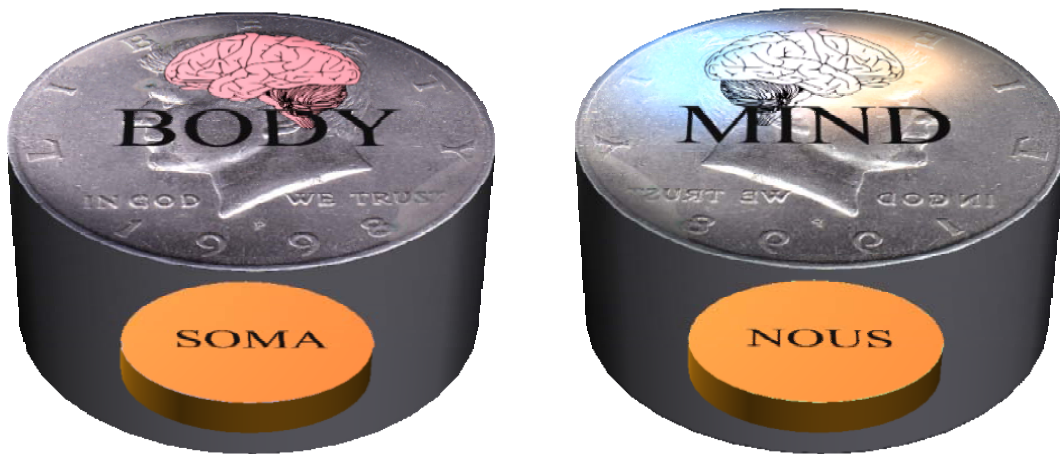


Figure 3.6. Knowledge of existence. (a) Shows the division of knowledge. (b) An example.

Mental physics calls the **notion** of the Dasein of body **soma** and the notion of the Dasein of mind **nous** [Wells, 2009]. Since mind-body are two sides of the same coin, nous and soma have concurrent Existenz (Fig.3.7). The animating principle linking **nous-soma** in a relationship of thorough-going mutual reciprocity is called **psyche** (Fig.3.7) [Wells, 2009]. The OB model is shown in figure 3.8.

(a)



(b)



Figure 3.7. Mind-body and nous-soma. (a) One side of the coin is body. The notion of the Dasein of body is the soma. The other side of the same coin is mind. The notion of the Dasein of mind is nous. (b) Thus, nous-soma are also two-sides of the same coin. The animating principle joining nous-soma is called psyche.

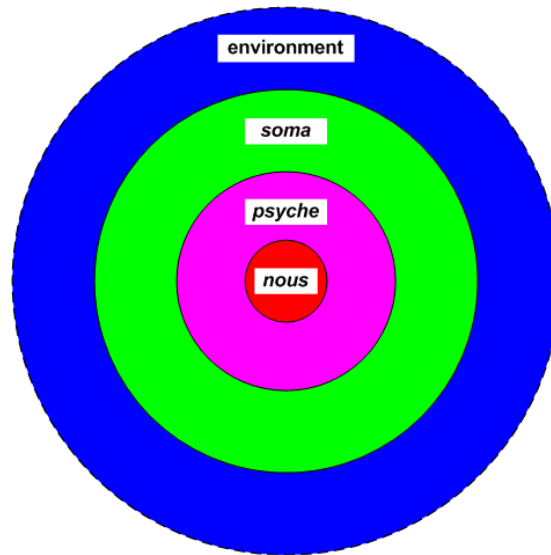


Figure 3.8. Model of the organized being (OB). And all OB's exist within the 'world model' which is an objective representation (parástase or depiction) of all-that-exists called **Nature** [Wells, 2009 Glossary]. Nature if applied to specific things (Nature of OB) is then the objective parástase of all its characteristics and relationships with other things.

Mind-Body relation to Nous-Soma

Since mathematics is a product of human intellect an obvious question is “How is mathematics able to truthfully tell us anything about objects of the natural world?” The answer is best described by the two-world model of David Slepian, one of the pioneers in information theory who in 1975 presented his model as a solution to the bandwidth-paradox [Slepian, 1976].

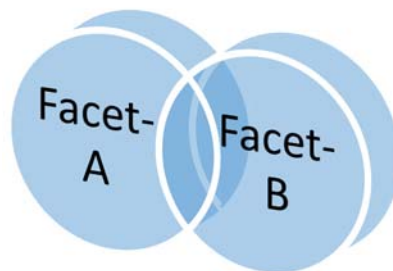


Figure 3.9. Slepian two-world model. Facet-A represent physical world and facet-B represent mathematical world. The intersection between the facets correspond to mathematical quantities (principal quantities) which immediately correspond to observables.

The description of the model is as follows. The physical world, the world of sensible objects and hence the world of experience and experiment is facet-A (Fig.3.9). The mathematical world, the world of mathematical objects is facet-B. When we force quantities in facet-B to correspond to measurements and observations in facet-A, then these mathematical quantities are called principal quantities. The quantities that do not correspond to observations in facet-B are called secondary quantities. Thus, secondary quantities are intelligible mathematical quantities with no direct counterpart in facet-A.

There are two fundamental principles for the two-world model:

- Two different mathematical models can produce the same physical situation. The mathematical measure of difference between the models was defined by Slepian as ‘criterion of distinguishability’.
- A necessary and important condition for a mathematical model to be useful in science is that the principal quantities of the model be insensitive to small changes in secondary quantities.

For more in depth knowledge on the model and its application to neuroscience the reader is directed to Wells’ publication [Wells, 2011d].

Since an OB experiences his/her mind-body, it is in facet-A of the two-world model. However, nous-soma is a product of human intellect (mathematical) and hence is in facet-B (Fig.3.10). On the question of whether mathematics is in nature or in the human mind, Jean Piaget says

“Does mathematics exist in nature, including the human mind, or does it exist outside nature ... and then you have Platonism? In the latter case, mathematics is the set of possibilities, and the real, including the human mind, is a tiny portion,

infinitely small with respect to the infinity of possibilities. But for me, mathematics exists in nature, and nature encompasses the human mind; the human mind develops mathematics with the body, the nervous system, and all the surrounding organism, which, itself, belongs to physical nature, in such a way that there is harmony between mathematics and the real world through the organism, and not through physical experience bearing on objects". [Bringuier, 1980]

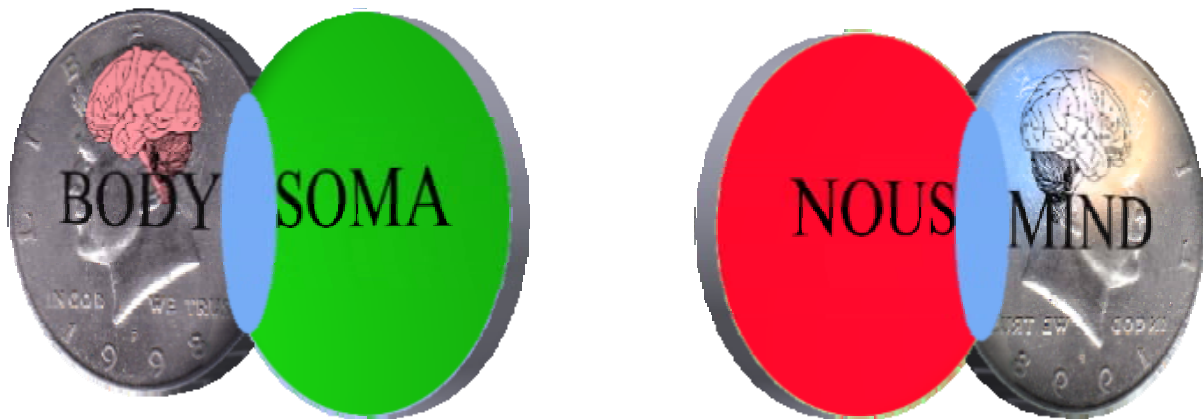


Figure 3.10. Application of Slepian two-world model to body-mind soma-nous division. Soma and nous represent mathematical world, facet-B (Fig.3.9) to respective physical world, facet-A body and mind.

Mathematical description of the OB

As a science mental physics results in the mathematical description of the Organized Being as shown in figure 3.11. Mental physics does this by divide-conquer, described by Francis Bacon as,

“The human understanding is, by its own nature, prone to abstraction, and supposes that which is fluctuating to be fixed. But it is better to dissect than abstract nature; such was the method employed by the school of Democritus which made greater progress in penetrating nature than the rest. It is best to consider matter, its conformation, and the changes of that conformation, its own action, and the law of this action or motion; for forms are a mere fiction of the human mind, unless you will call the laws of action by that name”. [Bacon, 1620]

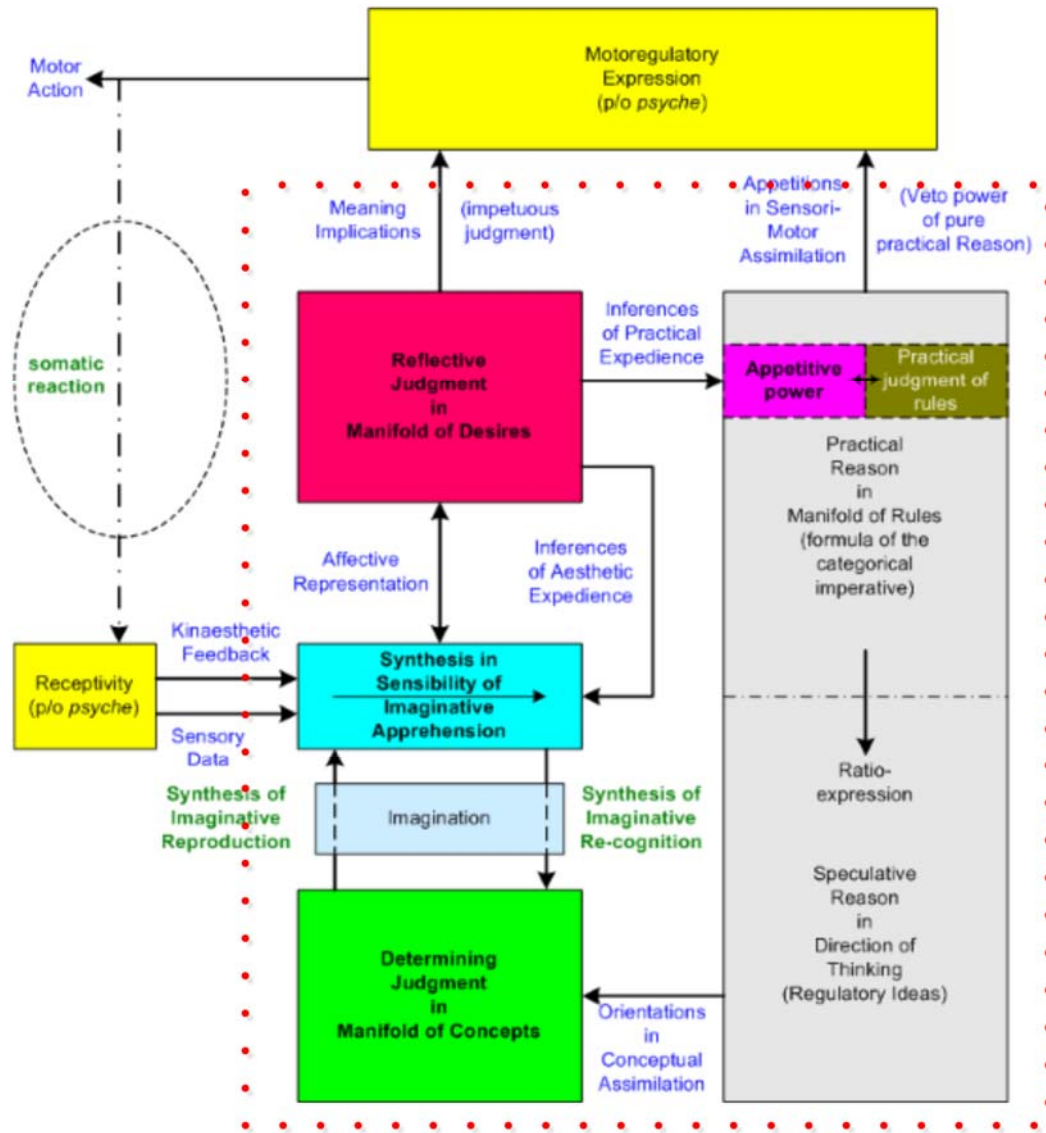


Figure 3.11. Mathematical description of the organized being (OB). The two yellow blocks are part of psyche. The blocks within the red dashed line are part of nous. The noetic or mental parastases always stand in thorough-going reciprocity with somatic parastase, i.e. they coexist in time.

The processes shown in figure 3.11 should be understood as functions with capabilities for production and transformation of parastases. The somatic parastases are called **signals** as they are physical phenomenon exhibiting variations in time that carry information. Mental physics abbreviates somatic-parastase to signal and noetic-parastase to parastase. The soma ↔ nous reciprocity and hence the relation signal ↔ parastase is handled by psyche.

There are two ways of understanding somatic effects:

1. Change in soma regarded as effect of environment on soma, i.e. soma $\rightarrow$ nous (Fig.3.12a). Mental physics calls the “capacity for soma to stand as the agent” of **representation** the **receptivity** of OB ($|\mathbf{RoOB}|$). In the co-determined nous, the sensuous depiction of the somatic effect is called sensibility. This is represented within the **synthesis of sensibility** block (light blue within nous part of the model/Fig.3.12a).
2. Change in soma regarded as co-determination of nous act, i.e. soma $\leftarrow$ nous (Fig.3.12b). Mental physics defines the “capacity for nous to stand as the agent” of representation the **spontaneity** of OB ($|\mathbf{SoOB}|$). The parástase is transformed to signal resulting in motor action in soma. This transformation is called **motoregulatory expression**.

The resulting soma $\leftrightarrow$ nous reciprocity is a fundamental real law of the OB. The Sensorimotor system of the OB as mental physics defines it is receptivity and motoregulatory expression taken together (Fig.3.12c).

The mathematical description is a generalization of the OB. But for this thesis, the discussion will be limited to a particular sub-function within the synthesis of sensibility block. This approach has been argued for by Francis Bacon as he warns,

“...for although the greatest generalities in nature must be positive, just as they are found, and in fact not causable, yet the human understanding, incapable of resting, seeks for something more intelligible. ... But he would be an unskillful and shallow philosopher who should seek for causes in the greatest generalities, and not be anxious to discover them in subordinate objects”. [Bacon, 1620]

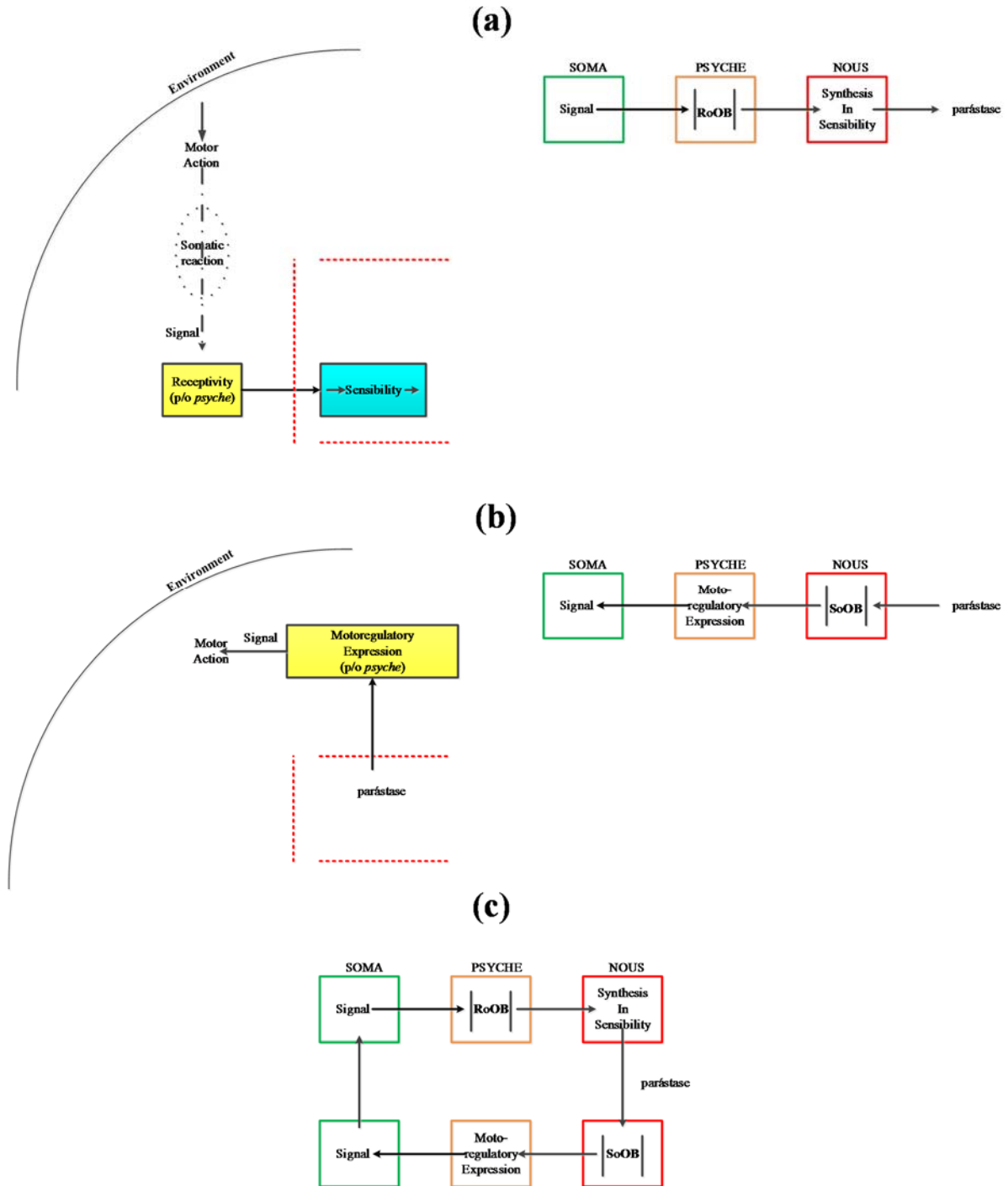


Figure 3.12. Two ways of understanding somatic effect. (a) Soma standing as the agent, soma $\rightarrow$ nous. Right hand side shows the block diagram view where signal is co-determined in the nous as sensibility. RoOB (receptivity of OB) is the capacity of soma to stand as agent. (b) Nous standing as the agent, soma $\leftarrow$ nous. Right hand side shows the block diagram view where parástase is co-determined to signal. SoOB (spontaneity of OB) is the capacity of nous to stand as agent. (c) Sensorimotor system, soma $\leftrightarrow$ nous. Block diagram showing receptivity and motoregulatory expression taken together.

Synthesis in sensibility

Synthesis in sensibility is a process within nous whose task is to transform obscure (unconscious) parástase to conscious parástase (perceptions). The obscure parástase or input to the process may be regarded as source of possible matter in conscious parástase. Thus mental physics calls them **materia ex qua** (matter out of which) or determinable-matter of parástase. The **materia ex qua** may enter via receptivity or somatic effect or from spontaneity or imaginative reproduction.

The resulting perception are of two types, **intuition** and **affective perception**. Mental physics defines intuition as perceptions in sensibility that refer to objects and affective perception as perceptions that refer only to subjective state of OB.

There are four synthetic processes [Wells, 2009]. This thesis will deal mostly with synthesis of **Verstandes-Actus** (acts of understanding). From a logical perspective Vertandes-Actus follow a logical progression in logical steps named **Comparison**, **Reflexion** and **Abstraction** (Fig.3.13). Kant tells us,

“The Vestandes-Actus, though which concepts are begat as to their form, are:

1. Comparison, i.e. the comparison of parástases among one another in relationship to unity of consciousness;
2. Reflexion, i.e. reconsideration as to how various parástases can be comprehended in one consciousness; and finally
3. Abstraction or separation of everything else in which the given parástases differ”. [Kant, pp.94, 1800]

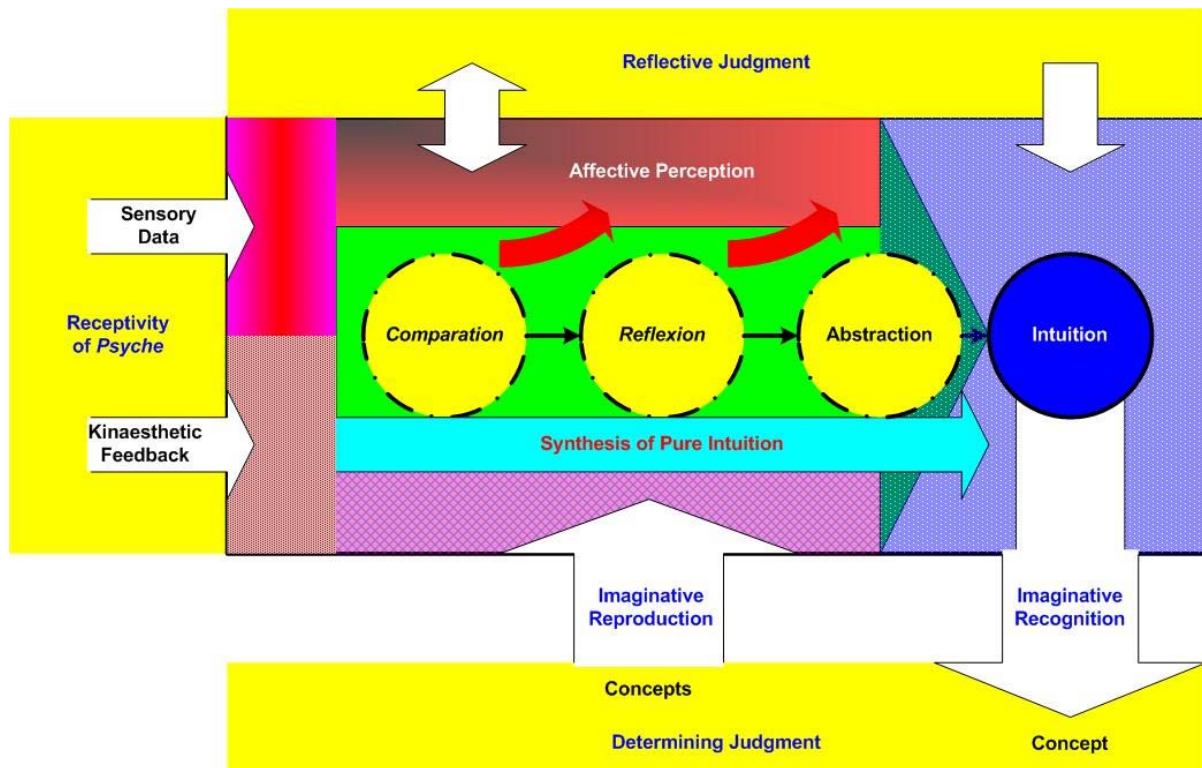


Figure 3.13. Illustration of synthesis of apprehension in sensibility. The *materia ex qua* from receptivity and spontaneity (imaginative reproduction in nous) enters the process resulting in intuition and affective perception.

Comparison is logical comparison

Comparison is defined as

“an act of *Verstandes Actus* of comparison (an act of understanding of comparison) making logical comparisons of compare *parástase* in the context of a relationship between them and unity of consciousness. In other words, comparison is the synthesis of equivalence structures” [Wells, 2009 Glossary].

Let us analyze this this definition. Logical comparison implies comparison using formal argument/s. What is it comparing? *Parástases*, particularly obscure *parástases*, and hence *materia ex qua* from soma (receptivity) or imagination (spontaneity) (cf. above).

Note that in comparison, this being an act of logical comparison, the resultant comparison made will also be obscure parástase, and hence a source of possible matter in conscious parástase. Thus the act of comparison does not pertain to immediate perception but rather preliminary preparation of matters-of-perception (sensation & feeling, [Wells, 2009]). Following the act, this obscure parástase becomes conscious parástase after the act of reflexion (subjective comparison). The project will deal only with comparison, i.e., equivalence relationship, and hence reflexion will not be discussed.

Comparison will determine whether compare parástase are possibly equivalent or not. This is done using the earlier mentioned definition of equivalence relations. That is, a model depicting comparison will perform the task of synthesizing an equivalence relation. Thus, the act of comparison results in a secondary quantity.

An inquisitive reader might ask “how do we know that the comparates and determination (of comparison) are obscure parástase?” Notice that we have been using the term **parástase** to differentiate it with **representation** which is a technical Kantian term (Vorstellung). This is not the same as ordinary usage. It is defined as,

“a primitive act of mind that tells the OB ‘something is in me that refers to something else’. Its matter is called composition and form is called nexus” [Wells, 2009 Glossary].

Parástase is therefore the outcome of representation. To understand a representation and hence parástase one must analyze the structure of representation. We can choose any level of structural analysis (x -LAR, x^{th} level analytic representation) [Palmquist, 1993]. Figure 3.14 shows 1-LAR and 2-LAR structure.

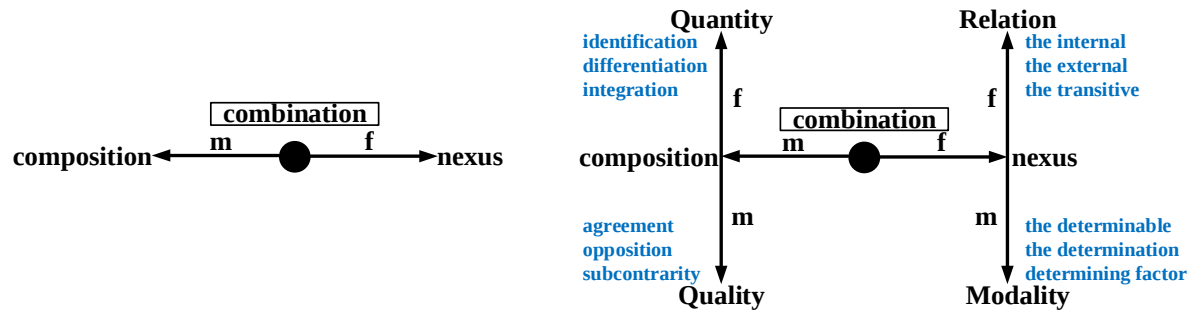


Figure 3.14. Dimensional structure of 1-LAR (1st level of analytic representation) on the left and the general 2-LAR on right. The letters ‘m’ and ‘f’ are for **matter** and **form**. Every structure of representation has composition (its matter) and nexus (its form). The composition and associated nexus must therefore combine to get a structure of the representation.

The poles, composition and nexus, can be further expanded in a 2-LAR. The poles of composition are then Quality (its matter) and Quantity (its form). The poles of nexus is Modality (its matter) and Relation (its form).

Since the 2-LAR is commonly used, functions, or **momenta**, for respective poles are given technical terms, e.g., agreement, opposition and subcontrarity for the pole Quality. Note that each pole has three functions because there are three standpoints or perspectives (theoretical, judicial or practical) [Wells, 2012] and because every synthesis requires three terms.

In most cases a 2-LAR structure is sufficient. Thus, its poles are given the technical terms **Quality**, **Quantity**, **Relation** and **Modality** [Wells, 2009]. Representation will not be discussed any further here and the reader is directed to chapter-2 of Wells’ text [Wells, 2009].

We analyze the comparates and determination (of comparison) using a 2-LAR. In other words, for these to be a parástase they must satisfy each of the functions with all four poles from a given perspective.

The determination by comparison is a secondary quantity but we want to understand human mind-brain and not just do some mathematical exercise. Thus one must always remember to link this to principal quantity/ies for objective validity. In other words, the model (built) performing equivalence relation (comparison) required connection of

implications. But all meanings are at root *practical* which is the perspective of comparison in its connection to motoregulatory expression in psyche (Fig.3.11). As explained below this linking provides *context* for comparison.



Figure 3.15. Linking secondary quantity/ies to principal quantity/ies. ● Represent secondary quantity/ies in facet-B, nous. ● Represent principal quantity/ies in facet-B, nous. ● Represent principal quantity/ies in facet-A, mind-body.

For the case of comparison: ● determination or result of act of comparison, ● instincts & preferences, ● neural & endocrine system physiology.

Principal quantities of comparison

Recall that nous is facet-B of corresponding mind (its facet-A) (Fig.3.10) and comparison is an act in the logical organization of nous (Fig.3.11) and hence is in facet-B. As mentioned above, determination by comparison is a secondary quantity.

For objective validity, this secondary quantity must be linked to principal quantity/ies in facet-B, nous (Fig.3.15) and also must be linked to principal quantity/ies in facet-A, mind. This is same as making the link to facet-A, body because mind and body are two sides of same coin. The question then is “what are the principal quantity/ies of facet-B, nous and facet-A, body.

In facet-A, body of the OB, its sensible aspect, is logically divided into two general classes of structures: stereotyped (rigid, inflexible to change) and non-stereotyped (adaptable) [Wells, 2011g]. Stereotyped structures provide innate capacities necessary for possibility of forming later developed structures [Wells, 2011g]. Jean Piaget call these “constitutive functions” which he defines as,

“Constitutive functions refers to those links or dependencies which are inherent in schemes of actions at a pre-operational level. These functions represent the point of origin, whether of operations which are properly of the subject or of causal systems at a level where causality consists of operations attributed to the object” [Piaget et al, pp.16, 1977].

The benefit of calling stereotyped structures “constitutive functions” is argued by Piaget as,

“The use of the term ‘constitutive functions’ has real benefit not only because it preserves the continuity between functions and operations without reducing the latter to the former but also because it makes possible a functional analysis of physical actions whose irreversibility renders them irreducible to operations. It is the attribute of the latter to objects which ends up by completing the external functional links until the causal explanation which derive from the system qua system are attained” [Piaget et al, pp.13, 1977].

Many neural (brain-stem, spinal cord) and endocrine structures are stereotyped and hence are “constitutive functions”. In contrast to expressions through biological maturation, structures formed in post-natal development of experience are then called constituted functions of OB [Wells, 2011g].

For building the fundamental blocks of semantic or contextual relations with soma we must therefore consider constitutive structures [Wells, 2011g]. In other words, neural and endocrine structures stand as principal quantities in facet-A (Fig.3.15).

In facet-B, nous of the OB it must overlay the constitutive structures. That is, its principal quantities must explain the **Nature** of phenomena of the constitutive structures. These are **instincts** and **preferences** (Fig.3.15). The reason why these are the principal quantities is explained from their definitions.

The term instinct used here does not have the same meaning as in everyday usage or common psychology usage. The term refers to what one might call Bergsonian instinct after Henri Bergson [Wells, 2011g; Bergson, 1911]. Understanding the practical significance of instinct gives us the meaning of instinct. This is summarized as

- Instinct is always accompanied by intelligence and never found in pure state because they are different and complementary. Quoting Bergson “what is instinctive in instinct is opposite to what is intelligent in intelligence” [Bergson, 1911].
- Intelligence considered as the original feature, is the faculty of manufacturing tools and faculty of indefinitely varying the manufacture. Thus, intelligence perfected is the faculty of making and using unorganized instruments while instinct perfected is faculty of using and constructing organized instruments [Bergson, 1911].
- Both instinct and intelligence involves knowledge but points towards unconsciousness for instinct and towards consciousness for intelligence.

Therefore, the sucking reflex of a baby in nous is instinct and in body the stereotype neural and endocrine structures, constitutive functions. Under motoregulatory expression the term preference will then be considered the subjective counterpart of instinct.

After identifying the principal quantities the question then is “how do we link them?” In other words, a judgment must be passed. However, comparison is a part of synthesis in sensibility, but synthesis of apprehension in sensibility (Fig.3.13) performs no act of judgment (as per mental physics). This is summarized by Wells as,

“(practical) Reason knows no objects and feels no feeling; sensibility makes no judgments; the categories of understanding provide not but local laws objectively valid only for sensible experiences” [Wells, pp.289, 2009] (also refer Fig.3.11).

Context for comparison

The process of judging sensible parastases (parastase in synthesis in sensibility, Fig.3.13) and hence the task of organizing the understanding of a system of Nature (Fig.3.8 for definition) is reflective judgment (Fig.3.13). Thus reflective judgment is the mediator for the relationship between comparison and motoregulatory expression in psyche.

The relationship between comparison and motoregulatory expression is transcendental, i.e., is required for the possibility of experience. This provides *context* for comparison. It should also be pointed out that since comparison is logical and its relationship to motoregulatory expression is transcendental, the somatic responses are transcendental. In other words comparison gets its *context* in part from relation to possible motor action (i.e., pre-motor response) and not actual motor activity.

Comparison is logical comparison, therefore it is judged by the form of reflective judgment called teleological reflective judgment (TRJ). Thus somatic and noetic co-organization is done by teleological reflective judgment (Fig.3.16). Hence *context* for comparison is provided in part by TRJ.

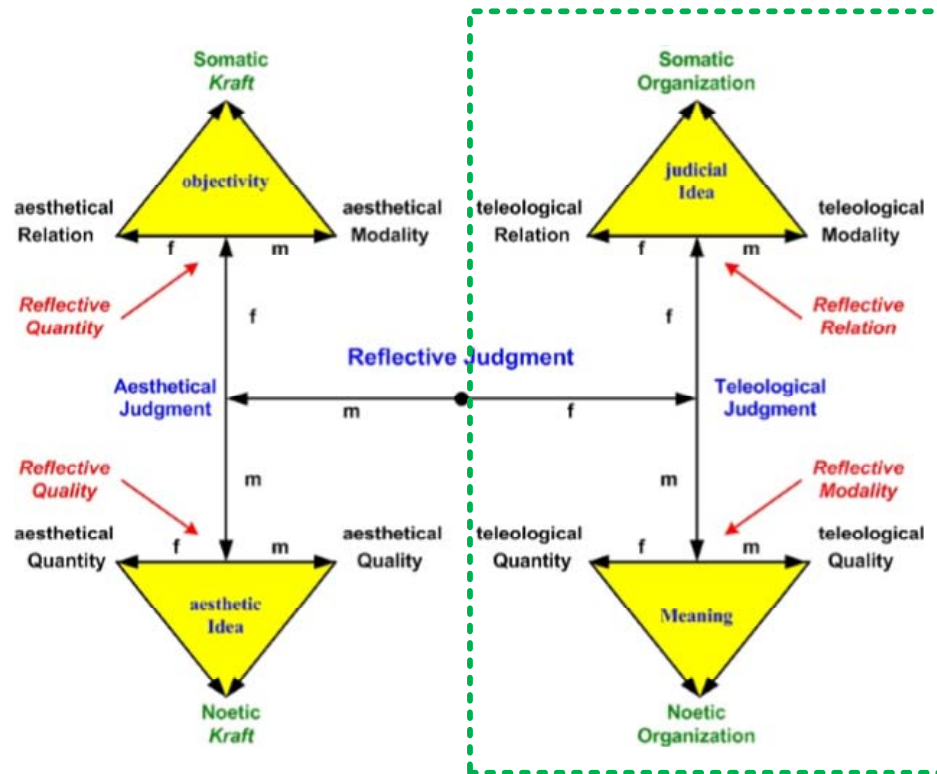


Figure 3.16. Relationship of reflective judgment and structure of division of psyche. Inside the green dash is the teleological reflective judgment that mediates comparison with motoregulatory expression of psyche by co-organizing soma with nous.

Grounds or basis for TRJ to judge comparison.

In the above discussion we have mentioned not only the linkages needed to be made between nous and soma but also the mediator, that is, reflective judgment (TRJ) which eventually provides part of the *context*. But these are requirements for objective validity of comparison. Therefore, an obvious question is “on what grounds does TRJ judge?” Put another way, “how or when does TRJ judge?”

As mentioned above, the determination by act of comparison is an obscure parástase. Thus, TRJ judges this parástase. But this parástase though obscure must be transcendental or possible for experience if there is going to be any nous-soma co-organization. This property of parástase is called **expedience** [Wells, 2009 Glossary]. What does it mean to be “possible

for experience”? This is the appetitive power of OB, that is, connection with *practical* purpose. The OB has one innate pure purpose of *practical* reason. This is called the **categorical imperative** which is a *practical* formula for acts to achieve a state of complete equilibrium.

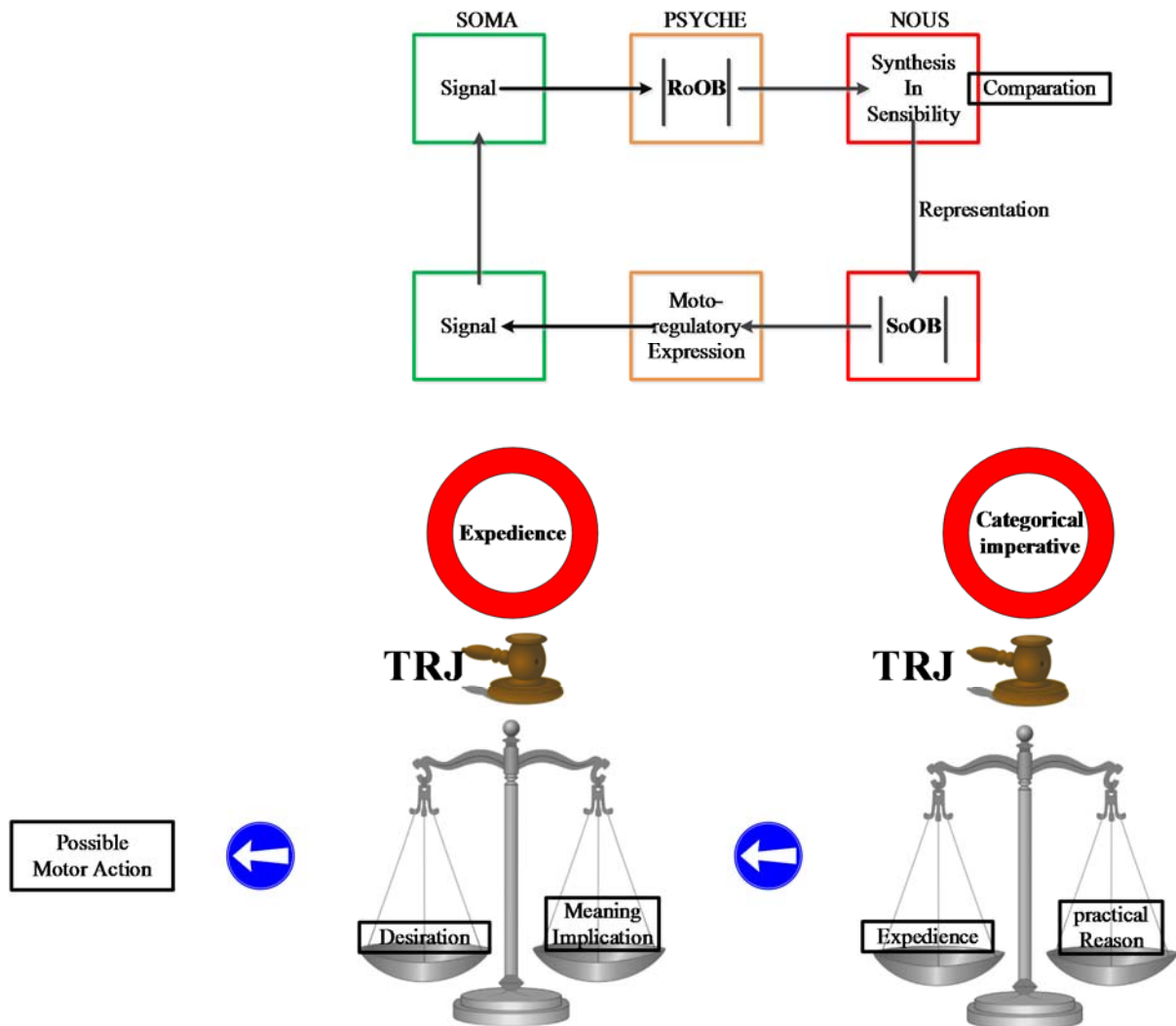


Figure 3.17. Basis for judging comparison by TRJ. TRJ judges the parastase from act of comparison by considering the property of parastase, expedience with respect to *practical* Reason on the basis of categorical imperative. TRJ also judges the determinable of motoregulatory expression, desiration with respect to meaning implication based on expedience. Thus judgment of comparison by TRJ results in possible motor action.

Therefore, TRJ judges comparison based on expedience which is then grounded by the fundamental law of acting unconditionally to achieve a state of complete equilibrium. In other words, TRJ judges the parástase when the act of comparison has reached equilibrium.

The determinable of motoregulatory expression is a parástase of possible appetite. This is called **desiration**. By meaning implication, TRJ judges desiration to be expedient, thus resulting in a possible motoregulatory expression. The connections of desiration are therefore the connections of acts of TRJ.

This shall end the discussion on the mental physics considered with comparison. In summary, comparison is logical comparison and hence in the mathematical facet-B world but requires linkage with motoregulatory expression in psyche mediated by TRJ providing semantic *context* for comparison. The basis for TRJ are expedience and desiration.