Conceptualizing in Special Sciences

~Ph.D. **Bogdan Boghitoi** *(Faculty of Philosophy, University of Bucharest)*
E-mail: bogdan.boghitoi@gmail.com

Abstract: *the paper examines a few methods for drawing categories that can be employed in special sciences. By examining some of the core phenomena that laid the basis of the most prominent approaches to typing in special sciences, it shows that we must accept a novel approach to delineating scientific kinds. Its peculiarity is that makes the latter parts of an array of structures, rather than possessing a fixed one. This can provide with a useful principal line of approach the leaders attempting to organize complex and evolving phenomena.*

Key words: concepts, special sciences, epistemology, evolution, functional, organization

One of the unfulfilled ideals of the modern mind is that of "unity of science". It is , at the core, a reductive ideal (Oppenheim and Putnam 1958). A key part part of its reductive approach consists, most often, in finding matches between the kinds one employs to theorize about certain processes and unique types of entities on a lower level in a mereological scale. This is widely assumed to provide reductions of the theory on the upper level to that on the lower one, and ultimately to the most basic, namely that of physics. Nevertheless this ideal, according to which every type of entity has to be shown to be ultimately equated with a definite type of microstructure, has been vehemently challenged. One source was the functional approach, originating in the philosophy of

mind. The origins of functionalism lay in the assimilation of our psychological states with the functioning of a Turing machine. The same way a Turing machine is characterized by a "machine table", which describes the transitions between an input, internal states and output, a physical system will have an internal functional structure, which describes steady causal relations between the sensory stimulations, internal states and the behavioral output.(Putnam 1967). Mental properties are nothing more than places typically held in causal chains. What individuates the mental states is their causal relations with the input and output. (see Lewis 1972).

One rather immediate consequence of the functionalist outlook is the multiple realizability. The causal structure involved can be realized by a host of realization bases, not amenable to a unique description in the language of the theories dealing with the inferior levels. Such functional descriptions of phenomena imply nothing with regard to microstructural properties of what underlies this web of causal relations. From this standpoint, a theory about the mind means tracking causes at this upper level, without specifying anything what the lower level phenomena implementing it are supposed to be. Any assembly of entities that can enter into the patterns of causation specified by the functional description would do.

Although functionalism has started as a stance on the theories about mind and behavior, philosophers have been quick to realize that the same issues at the core of this approach also face other special sciences. There are situations where our only chance to make science is to track this upper level causal chains, between items that are typed so that they would be capable to enter into stable causal relation, but without being capable to effectively indicate any fixed microstructural pendants. As Fodor remarks (Fodor 1974), there are scientifically interestening general statements that can be made about items whose physical description has nothing to do with each other. Whatever they have in common according to this lower level descriptions has nothing to do with the truth of the upper level generalizations. One example to this point could be economic general statements, such as those concerned with monetary exchange (e.g. Gersham's law). Nevertheless money can have different physical make-ups, like coins of different metals and sizes, banknotes, a certain electrical charge in the memory of a computer (in the case of electronic money), they can be wampoons and so on. Such examples strongly suggest that any description of the physical realization of money must be wildly disjunctive. Nevertheless when it comes to monetary exchange, whatever the physical structure of money, we are bound to attend to the upper functional level because there are here interesting generalizations that otherwise would be missed.

Of course, there is also a backlash. According to Kim microstructure is crucial for having genuine natural kinds because the macrophysical properties are determined by microstructure. Take for instance jade, which is not a true mineral kind. "Jade" designates actually two different substances, with unlike molecular structures, namely jadeite and nephrite, although its surface properties might be similar, and we might employ both substances for similar purposes, which makes us to employ the naïve taxonomy we use in our daily lives. Nevertheless being jade cannot be a scientific predicate, as any

putative law containing it has problems with projectability. We simply won't have any guarantee that any new instance of jade will behave in a the way we anticipate it would do, as we would expect by inductive reasoning based on the properties of a given pool of jade items we already investigated. It might for instance, simply turn out that all the samples of jade examined so far by scientists in order to determine how it behaves in certain circumstances – for instance how it reacts to a certain substance - might be actually nephrite, and we have no way to extrapolate the results to a new instance of jade which is made out of jadeite. What guarantees the similarity in behavior is the microstructure of the instances. Were jade to have a unitary microstructure, we would be entitled to predict from the instances we already examined the behavior any future jade piece will have. Entities having similar microstructure behave similarly. Thus it is necessary to belong to a given natural kind to share the same microstructure, which in turn, as Kim quite elegantly shows allows a smooth microstructural reduction. (Kim 1992)

We won't try a direct refutation of one or the other of the arguments produced by one or another of the two antagonistic approaches in order to establish its indispensability when it comes to determining what is to count as a natural kind. The dispute between the two camps already generated an abundant literature, to which we won't attempt to add. What we intend is propose a third way of typing. It preserves the multiple realization, while being irreducible to both previous approaches. In this respect, we will try to get as much help as we can from a case study in the very field that kickstarted functionalism. Namely, we will try to examine what would work as an effective procedure for categorizing the modalities, therefore some of cognitive processes. What this analysis will put forward is a method of categorization that is neither functional nor microstructural. This pleads for a multitude of approaches when it comes to defining classes in special sciences, turning special sciences into a patchwork with local rules rather than an unified landscape, where one method would assert its hegemony. Regardless of the value of the functional approach, the microstructural individuation of scientific kind and even the functional approach to be supplemented by another approach, that relies on the evolution of a certain structure (be it described in terms applying to its macrophysical or microphysical makeup), not on its intrinsic characteristics.

Thus, what we would like to do is review the criteria traditionally employed for individuating the sense modalities. They are a mix of functional and microstructural approaches, which unfortunately don't succeed to establish a viable criterion for what is to be a certain sense. The modern discussion on the issue of the modality individuation was practically initiated by Grice (Grice 1962), who identifies 4 criteria by which senses could be distinguished. To these four criteria, which acquired both friends and foes, the literature on the subject added a few more, that we need to discuss also. As a result, we can identify seven criteria that can provide support in our attempt to have clear cut scientific kinds.

1.One way to decide what counts as a certain modality is to rely on what we become aware by the means of them. For instance sight makes us perceive whiteness and or roundness, while hearing makes us perceive sounds of a certain pitch, loudness

or with certain tone qualities1. This is at the root a commonsense functionalist approach to individuating the modalities. The core intuition is that we "hear" or "see" such external properties of things, which impress our senses and this sensing of specific qualities is what is to be a certain modality. But although many times folk psychology might get our mental states right and inspire valid approaches in science, coming up with clear cut formulae inspired by it, isn't always easy. In occurrence, the present attempt to get criteria for typing doesn't seem to work. On one hand, certain advances in this field of research, in conjunction with rather well studied phenomena, show that none of the proper contents of sight is necessary. First, it is not necessary to see colors in order to have vision – total achromatopsia does not prevent us from attributing sight. Also, there is the case described by Zeki (Zeki at al. 1999) , of a patient whose visual experience was limited to colors only. He was insensitive to shapes, spatial position and, generally speaking, none of the other contents populating our vision. These two pathologies encompass practically the whole range of visual experiences of men, so none of the things vision makes us aware seems to be required. On the other hand becoming aware that a certain thing has a definite color or shape can be done by the means of other senses (for instance because we hear someone telling us that this is the case). Therefore this approach cannot provide us with sufficient criteria for a certain modality.

2. senses can be told apart by the special introspective character of the experience they sustain. Regardless of what we learn through them, the experience of seeing is qualitatively different from the experience of hearing. The sheer difference of what when we subjectively experience when we see or hear makes us capable to tell them apart. This criterion, of a definite philosophical origin, makes use of the qualia that it functionalizes. They act as triggers for a certain internal process that makes us aware of the different types of perceiving.

But as Keeley notices (Keeley. 2002. pp. 23-25) such a criterion has difficulties dealing with the vomeronasal sense. The peculiarity of vomeronasal sense is that detects pheromones but it does not produce any accompanying qualia. Although the evidence for such a system is piling up, the existence of a vomeronasal system in humans is controversial, as Keeley dully notices. Nevertheless, the argument can be completed, so that it could cope with these prospects.. What we should notice above all is that the problem is conceptual. We can very well conceive a sense that feeds data into cognitive subsystems that are inaccessible to the conscious parts of our psyche, thus failing to generate any qualia. After all, much of the data the nervous system processes remains unconscious. A scientist needs to operate with such a concept of sense, which does not require individuation by qualia, in order even to formulate its hypotheses. And do we know that in animals where such a system is functional it does produce qualia? To my knowledge no scientist has approached such a problem, let alone making qualia a necessary criterion for asserting that a certain species possess a specific sense. Therefore, the attribution of

[1] The proprieties involved should be clearly distinguished from those of the subjective experiences and of the physical phenomena, making possible a certain type of sensory experience, that will be discussed below.

modalities does not seem to depend on presuming specific qualia.

3. Another criterion that has been advanced relies features of the physical events which activate them. It ultimately substitutes the typing of stimuli in terms of the macroscopic properties (color, shape and so on) with their microphysical basis, as described in the language of physics. This is the criterion endorsed by Heil (Heil 1983). According to Heil modalities are to be distinguished (insofar as possible) by reference to the kinds of "physical stimulation" enabling the creature to extract information from the environment (Heil 1983, p.8). For instance seeing extracts information from light, hearing from certain types of pressure waves and so on. Heil admits that senses cannot be sharply distinguished. Nevertheless, if one attempts to use such a criterion to draw sharp demarcations, he will face serious problems, especially with constructing a set of physical events that is necessary for individuating senses. For instance nocioperception, that is perception of pain, is activated by a vast variety of physical events, none of them necessary for feeling pain. Contact with the substances liberated by the stings of the nettle or electric shock produce pain in humans but for other other species it might be innocuous, or irritating substances might fail altogether to activate pain detectors, which are activated instead by other events. Actually, for each type of physical event producing pain in humans, we can imagine a species that are insensitive to it, while still possessing nocioperception, so none of them is necessary.

4. The fourth (and the last) Gricean criterion is the internal mechanisms of the senses, or as Keely puts it, the character of the putative sense organs and their modes of connection with the brain.(Keeley 2002:13). We should look at the anatomy of the sensory organs and of the nervous system. Thus, we need to find a certain organ responding to certain types of physical stimuli, certain determinate nerves and a certain organ, like the brain, where these neurons lead to. This is an obviously microstructural criterion. Anyway, the it will have to deal with he anatomical diversity of the sense organs emphasized by Pacherie (Pacherie 1997: 19). We can't take as reference the peculiar anatomy of human sense organs, as the compound eyes of insects are very different in their anatomy. We shall come back on this criterion as on one hand, I shall attempt to show, as it is not entirely devoid of any value. On the other hand we have to face the fact that Pacherie points at one of its genuine weaknesses.

5. There is also the criterion of "dedication". (Keeley 2002, p. 17), that is "the evolutionary or developmental importance of the putative sense to an organism ". We should not attribute a certain sensory modality unless the sensed proprieties are part of the environmental variables to which the organism is evolutionarily attuned through past natural selection. For instance we should not posit an electric sense just because we can sense electric discharge from a battery we put on our tongue. Criterion (5) attempts to select as sense just what is biologically important for the organism. The problem is that any physical stimulation that the organism can detect can become important for it. Just because an organism can respond to a class of stimuli does not mean they are important for him.

The problem is that from an evolutionary standpoint it is impossible to trace demarcation lines between what is important and what is not. Being shaped by natural selection

for performing a certain function can't help us here, nor, as we shall see, trying to make this criterion a bit milder. As it happens, the biological function an organ performs shifts. Expatiation is quite a common phenomenon in the living world. It makes structures that evolved to serve a certain biological function to be subsequently recruited for serving another. Sometimes the environmental conditions change, so that the function does not get to serve anymore the purpose it was selected for, but continues to serve its exapted function. So what is now a sense for something, might have have appeared for entirely different reasons. Take for instance a species marine animals S, which evolved a tongue whose purpose is to pick the chemical trail left by pray A. As it happens the peculiar structure of the tongue enables it to pick the electric discharges. Sometimes in its evolutionary history pray A disappears and pray B enters the scene. The muscle discharges of pray B can be picked by S, which can thus hunt it effectively. Shouldn't we credit S or with an electrical sense? We probably would, but that would mean the demise of this criterion. Thus, any physical event an organism can detect can become a stimulus with a certain evolutionary import, given the right circumstances.

One might reformulate the criterion more liberally, by dropping the condition that it should have evolved specially for that purpose. Thus biological import might be taken to refer to anything that has consequence with regard to survival. The electricity detection capabilities might be affecting S's survival positively or negatively (for instance if eating B leads to poisoning, in the long run). But if pray B disappears, and as a consequence such a detection capability loses its importance, should we say that the animal has lost one of its senses? What if we purposefully introduce B into S's environment? Should we then say that we endowed S with a novel sense? But the strangest consequence is this: imagine that some of the members of S learn to use the electricity detection capabilities of their tongues in order to hunt B, while some don't2. Thus electrical detection is important for some of the members of S while for others is irrelevant. Should we say that some of the members of that species has an extra sense while others lack, moreover in the conditions where there is no anatomical difference between them?

6. Another criterion proposed by Keeley is the ability to discriminate behaviorally between stimuli that differ only in terms of a particular physical energy type " (Keely 2002, p. 15). It is peculiar application of a method routinely employed scientists and philosophers embracing the functionalist creed in order to infer that someone has a certain property. Nevertheless, it is made to yield, amongst the criteria advanced by Keeley for determining modalities, probably the weakest. We have no idea how this can apply to people who suffer from total paralysis. Should we hold that they are deprived of hearing or sight just because there is no behavior they can issue? Also it is hard to see what these energy levels could mean when it comes to senses like taste. What taste detects is differences in molecular composition of various substances, rather than the differences in kinetic energy of the molecules (which is detected by thermal receptors).

[2] This might be imagined as a result of a regular naturally occurring reinforcement process, whereby some individuals are by mere chance rewarded a sufficient number of times, at the rignt moments, to acquire the new behavior.

7. There is another idea that has been pressed too into work, at least tentatively, as a criterion for individuating the senses, which tries to exploit Noë and O'Regan's enactive treatement of perception. It is this time a functional approach, which nevertheless replicates on this upper echelon a problem we previously encountered with regard to a microstructural criterion. According to it, for each sense there corresponds a type of exploration of the world that is underpinned by of specific "sensorimotor contingencies", that is laws governing the sensory changes produced by determinate motor actions (Noë and O'Regan, 2001, p. 943). For instance to see is to be capable to master vision-related rules of sensorimotor contingency. It is unclear how much this idea was intended to be turned into a full-blown criterion by Noë and O'Regan, but some others have taken it to function as such (Auvray and Myin 2009, p.1046). The trouble is that in spite of the role sensorimotor contingencies may have in the way we sense the world, they cannot provide necessary conditions for circumscribing modalities. For a start, in order to decide that whether a certain organism having photoreceptors see or not, we will rather need to know which these specific contingencies are. Saying that they are vision-related is clearly circular. In order to escape circularity, we need a way to independently pick them up, which is really a tall order. We quickly find ourselves mired in basically the same difficulties Pacherie showed must be faced by anyone trying to exploit the anatomy of the sensory organs. The reason lies too in the diversity of mechanisms we must expect in the living world. Thus, we might envisage the possibility that these sensorimotor contingencies, associated to a certain modality, might vary from species to species. For instance finding that cats have wildly different sensorimotor contingencies compared to humans, won't preclude biologists or animal psychologist attributing them vision. Moreover, genetic or developmental accidents might modify these mechanisms even further, possibly without any principled limit. The viability of the criterion depends on effectively proposing an independent set of sufficient and, more important for us, necessary conditions for any possible sensorimotor contingency linked to a specific modality, which nobody has attempted.

We have tracked so far a few analyses that, beyond rather merely methodological proposal of the two camps we mentioned in the beginning of this paper, have effectively tried to come up with criteria for individuating sensory modalities Although none had a doctrinal ax to grind, they could be easily pigeonholed in one or another of the two grand approaches. They all failed, but their demise leaves us with a heritage. We can learn from their shortcomings, and and build viable criterion for individuating sensory modalities. Ultimately, this way of individuating the senses will help us better appreciate the patterns of conceptualization in special sciences, attesting to typing practices that which cut across the functional – microstructural divide.

We propose to look once again at the criteria four and seven. Both relied on the inner mechanisms, one of the level of the anatomy and the other at the level of the "software" it implements. Both failed because they had as a consequence an unpalatable chauvinism, which takes a certain mechanism.

For one thing, biological kinds, be they cognitive or otherwise, require a certain

degree of flexibility with regard to the peculiar makeup of mechanisms they designate, even within one and the same species. For instance a certain mutation might introduce modifications in the standard way a certain physiological process is carried out. For instance a certain mutation, through the physiological changes it induces, might induce color blindness, yet we won't consider the color blind persons as being deprived of vision. Also disease can modify the way the way that a certain biological process unfolds. Yet we won't for that matter place it under another biological category. For instance digestion affected by an ailment will still e considered digestion, albeit pathological digestion.

The case of a mutation introducing variants is even more instructive. The nonstandard way of carying out the task might grant the owner of such an organism an evolutionary advantage. For this reason it can spread in the population where it arose. The group characterized by that mutation can even differentiate itself to the point as to starting a new species. This is after all, inter alia, the way speciation is presented by evolutionary theory. Such remarks are capable to put us on the right track with regard to a criterion for modalities. Take a certain structure which we know characterizes the way at some point in time the cognition of a given species normally works – in occurrence a certain sensory modality. Some modifications of this structure will still have to instantiate that kind, although the way it works, spelled out in the language of the upper or lower level theory doesn't conform to a standard pattern.

We don't pretend that all such modifications of mechanisms preserve the sensory modality. Certain changes will definitely impair vision. Nevertheless, I think we can draw quite a neat line here. The modifications that suppress sight or hearing will suppress any delivery of the information of the sort the previous structure delivered to the other structures of the brain. For instance there are instances such as those of blindsight. In blindsight cases subjects that are cortically blind, and for that matter are not consciously aware of certain events that we usually become aware of by visual means, are capable to issue certain responses to visual stimuli. The lack of cortical awareness is most certainly due to damage in the primary visual cortex, which cuts the flow of information towards other brain areas. Nevertheless seemingly paradoxically, scientists are still capable to credit such patients with sight. There are several theories about the neural mechanism that enable such subjects to unconsciously see events outside them (see Weiskrantz 1990, Kalat 2009, pp. 169-170, Cowey 2010 etc) . Whatever the truth, sight can be attributed exactly to the measure to which parts of the normal information are delivered, by the means of cortical structures that are still intact, further into other subsystems such as control of the eye movement or any other parts of our neural architecture that control the responses the subject is still capable to issue. If we are to scrutinize to the scientific practice, we will observe that sight is attributed to the extent that such information is made available downstream to other structures whose role is to take over this information, and denied to the extent that the contrary happens.

Given these limitations, we have here a recursive procedure by the means of which to determine what is to be allowed to exemplify a certain modality. It is not having a

specifiable structure. The way sight or hearing work can be modified in many ways. Having sight or any other modality is rather belonging to a certain continuum of modifications, as effected initally by evolution by natural selection, which created the ur-mechanisms for each modality and continued to tinker with them, but also by many other processes that impact sensory cognition.[3]

More generally and one step closer to our ultimate goal, this approach to sensory modality individuation documents a certain way scientists proceed in carving the kinds they use. It is neither functional nor microstructural. This continuum is ensured by a process of change that occurs both on the level of "hardware" as in that of "software". Damage to certain pathways or a genetic accident change can impact the way our neural structures work, which in its turn may impact the functional level. Also, certain odd developmental circumstances can result in nonstandard routines involved in information gathering. This rule of drawing does not make reference to any of the levels involved. Moreover, it isn't reducible to any of the other two approaches, as it doesn't employ a specifiable structure, describable in the language of the lower level theory or in that of the upper level one, because any such specification would imply the chauvinism we were talking about above, and that was emphasized by Pacherie.

This isn't just something that is specific to cognition. The same rules can account to other scientific practices, such as those in economics. Take for instance money. When they were invented money were pieces of stamped by an authority so that it would guarantee the content of the token. But as Fodor emphasized, money can't be typed by pointing at the microstructure. At first, money were made in electrum (a natural alloy of gold and silver), then in gold, in silver , copper, paper or as, electronic money, their realization base is whatever material is employed for storing information abot people's accounts[4]. What Fodor failed to see is that money paticipate in a variety of exchange patterns. But the pattern of economic interaction and exchange can be endlessly modified to. The limit is only our whim, as we can legislate at will so that to change one or another of the patterns of economic interaction in our society. Therefore we won't be able to pick up an uniquely describable pattern of interaction where money play a role, so that we could individuate money irrevocably. Nevertheless we won't be deprived of such an economic kind, as we can define it with reference to a certain evolutionary process, to which various forms of money participate.

This way of carving kinds is not antagonistic to microstructural typing, nor to employing functional relations to the same end. One can legitimately define functional categories. For instance one can speak about modern human speech production or primate vision, by identifying the patterns into which such types of processes enter in the

[3] This continuum might be shaped by selective pressures "that attune" our senses to environmental significant events (as crterion 5 requests) or not. Evolution is not the only force impacting peculiar instance of a certain sort of biological processes. As we have seen, the changes can be induced by various processes such as maladies that disturb the regular physiological mechanisms.

[4] Although the istory can be traced even further back, to some premonetary items used in exchange (for a comprehensive history of money see Davies 2002)

case of each current species. Thus, it might be discovered that modern linguistic faculty might employ certain defining algorithms in order to compose syntactically complex utterances, that can be spelled out functionally. Modern speech might have no forerunner in a simper form of verbal behavior hominids were capable of. The modes of communication employed by our ancestors might have lacked those algorithms, which are essential for language. In this scenario, there would have been an explosion of language that occurred with the emergence of the Homo sapiens, that would allow only functional typing of the linguistic processing, making the language faculty a local phenomenon peculiar to our species (and which might never evolve any further). The only theoretical endeavor scientists can engage into would be deciphering these algorithms bursting onto the scene of evolution. We can even hold that such a functional upper-level architecture described by the algorithm that produce speech reduces to a neural architecture that is idiosyncratic to the homo sapiens. But the opposite scenario is also possible. It might equally turn out that our ancestors did posses a simpler form language, based on a more rudimentary system of transformations, that engendered a different verbal behavior and which is underpinned by less developed neural structures. This simpler functional structure is the one that evolved into our current language faculty (which we might describe functionally at the psychological level or microstructurally, on the neural level), and in this case having a proper concept imposes to take the route we are pointing at. Moreover our stance makes us capable to specify local functional structures, describing how a certain cognitive process works in one precise population at a given time, as well as with a microstructural account of what makes its members tick. This situation illustrates how the functional and the microstructural typing as well as the approach we are trying to make visible can coexist and pressed into the line of fire to provide us with the conceptual ammunition needed to tackle the need for principled ways to organize our knowledge.

Our approach does not of course claim to refute the reproaches made by the microfunctionalistic camp to the idea of functional theory. This is an entirely different and quite a vast issue. Nevertheless it undermines its hegemonic and reductionist pretenses. It shows that we can have a kind which underpinned by a heterogeneous group microstructures, but which are held together, under the umbrella of the same kind, by sharing the same history of change .

This phenomenon is not only of epistemological import. It is extremely important for the leadership in times of change. The morals for the manager is that s/he should not always find essential structures that animate organizations or economic practices persisting over time. Sometimes the phenomena in the realm of special sciences, from biology to economy, have to deal with concepts spanning over an array that could potentially end up including members with no structural commonalties. Nevertheless, our paper provides him or her with an outlook that can help him or her tackle the change principally, encouraging setting analysis units at the level of these variegated continuum.

Acnowledgements

This work was supported by the strategic grant POSDRU/89/1.5/S/62259, Project "Applied social, human and political sciences. Postdostoral training and postdoctoral fellowships in social, human and political sciences," cofinanced by the European Social Fund within the

Sectorial Operational Program Human Resources Development 2007 – 2013.

REFERENCES:

1. **Auvray,M and Myin, E** (2009) *Perception With Compensatory Devices: From Sensory Substitution to Sensorimotor Extension,* Cognitive Science 33,1036–1058.
2. **Cowey A.** (2010) *The blindsight saga* , Exp Brain Res 200:3–24
3. Davies, G. (2002) *A History of money from ancient times to the present day,* 3rd. ed. Cardiff: University of Wales Press,.
4. **Fodor J. A.** (1968). *Psychological Explanation: An Introduction To The Philosophy Of Psychology*. Ny, Random House.
5. **Fodor J. A.** (1974). *Special Sciences (Or: The Disunity of Science as a Working Hypothesis*). Synthese 28 (2):97-115.
6. **Heil, J.** (1983). *Perception and Cognition.* University of California Press.
7. **Grice H. P.** (1962). *Some Remarks About the Senses. In R. J. Butler (ed.),* Analytical Philosophy, First Series. Oxford University Press.
8. **Kalat, J. W.** (2009). *Biological psychology.* (10th ed). Wadsworth Publishing.
9. **Keeley, B.** (2002) *"Making sense of the senses: Individuating modalities in humans and other animals,"* The Journal of Philosophy, 99, 5-28.
10. **Kim J.** (1992). *Multiple Realization and the Metaphysics of Reduction*. Philosophy and Phenomenological Research 52 (1):1-26.
11. **Lewis D.** (1972). *"Psychophysical and Theoretical Identifications"*. Australasian Journal of Philosophy 50: 249-58
12. **O'Regan, J.K., & Noë, A.** (2001). *What it is like to see: A sensorimotor theory of visual experience.* Synthèse, 129(1), 79-103.
13. **Oppenheim, P and Putnam, H.** (1958). *Unity of Science as a Working Hypothesis.* In Herbert Feigl, Michael Scriven & Grover Maxwell (eds.).
14. **Pacherie, E.** (1997). *Du problème de Molyneux au problème de Bach-y-Rita.* In J. Proust (ed.), Perception et Intermodalité, Approches actuelles du Problème de Molyneux,, Paris, PUF, pp. 255-293.
15. **Putnam, H** (1967) *"Psychological Predicates"*, in W. H. Capitan and D. D. Merrill, eds., Art, Mind, and Religion (Pittsburgh: University of Pittsburgh); reprinted as "The Nature of Mental States," in Ned Block, ed., Readings in Philosophy of Psychology, vol. 1 (Cambridge: Harvard University Press, 1980).
16. **Weiskrantz L.** (1990)Blindsight_ a case study and implications , Oxford Clarendon Press
17. **Zeki, S. Aglioti, S. McKeefry, D. and Berlucchi G.** (1999) The Neurological Basis of Conscious Color Perception in a Blind Patient , in Proceedings of the National Academy of Sciences of the United States of America, Vol. 96, No. 24 (Nov. 23, 1999), pp. 14124-1412