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From brain to mind to consciousness – without hard problems.

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ABSTRACT:

The need and possible sources of the phenomenology of consciousness are stressed. Naturalistic solution to the problem of consciousness is in agreement with the growing number of experimental facts. Mind and brain states are two ways of looking at the same reality. Conscious experience is an experience, i.e. a particular relaxation of the mind/body system. Plausible connection of mental and brain events is outlined. Phenomenological theory of consciousness is sketched and the solution to problems involving consciousness outlined.

KEYWORDS: cell assemblies, cognitive philosophy, cognitive science, consciousness, inner space, mental representation, mind, mind evolution, mind-body problem, philosophy of mind, psychophysics, symbol grounding.

1 Understanding consciousness - how far can we go?

The first problem in the research on consciousness is to clearly define what the real problem is. What should we explain? Many physicist think that some unified *Theory of Everything* (TOE) will explain consciousness together with everything else (cf. Penrose 1989, 1994 writing on quantum gravity and unified theories). Of course this goes along the respected reductionist tradition of physics: to understand something means to reduce it to more fundamental concept and build models that are based on such concepts. However, in case of consciousness this is not and will never be sufficient! This point is worth some explanations since it seems to be frequently misunderstood (Gray 1995).

Suppose that we find a beautiful equation describing the behavior of mind, an analog of Schrödinger equation for the mental events. Mathematicians may be happy about it but it will not reach the world of my personal experience. We may say that we already have such an explanation: the dynamics of the brain excitations produces the mind. How does that differ from field-theoretical concept of consciousness, like those proposed by Eccles and Margenau (Eccles 1994)? Will we understand more if a field of “psychons" we be postulated and individual minds understood as some activations or vertices of such field? Will my personal experience be explained if quantum mechanical processes in the brain will be discovered and invoked to explain conscious experience (Stapp 1993)? This is not where the real problem lies.

The real problem – the “hard problem", as Chalmers (1995) calls it – is to understand the first person experience, consciousness as an experience. All that we perceive and understand, all that happens in our mind is an experience. Consciousness is a particular experience, an experience related to a thought about myself. I am, I see, I observe, an interplay of “I", a subject, and an object, or contents of consciousness. No fundamental physical theory can tell us about this feeling or make it less mysterious in our direct experience. This is where we find the limit of external description, or limit of our modeling power – the ultimate understanding must refer to the experience, not to words pointing at the experience. Books in the perennial wisdom tradition are full of paradoxical descriptions referring to this point: we cannot explain the basic experience of just being. A story from Anthony de Mello (1985), a contemporary Jesuit spiritual teacher, clears that point:

What does your Master teach? - asked a visitor.
Nothing - said the disciple.

Then why does he give discourses?
He only points the way – he teaches nothing.

Indeed, we cannot learn the experience of being conscious from books, it is a first person experience. Consider the famous passage from the Lao Tzu's "Tao Teh Ching", translated by a contemporary Taoist teacher (Ni Hua-Ching, 1979):

Tao, the path of subtle truth,
cannot be conveyed with words.
That which can be conveyed with words
is merely a relative conception.
Although names have been applied to it,
the subtle truth is indescribable.

In this translation the passage is quite clear: names have little to do with reality. Experience of reality is not reality itself. One may learn names and descriptions but it is not the same as learning by doing, Basic distinction in neural modeling is between supervised learning, where a "teacher" corrects the outputs of the system, and unsupervised, self-organizing learning, something that children do when they learn to walk and to talk. Great Tao of Chinese philosophy, the natural flow of things, is learned in an unsupervised way, by adapting to circumstances, in contrast to scholarly learning of symbolic descriptors. From the point of view of human experience these two ways of learning are very different and engage different brain stuctures.

Why am I bringing all this here? To be able to discuss consciousness we need first its phenomenology (Gray 1995, makes this point too but does not know where to look for it). Consciousness seems to be quite obvious and yet very hard to pin down. Psychology has proven many times that we frequently deceive ourselves and we should not trust our sense of "self" any more than we trust our sense of smell or hearing. It does not seem likely that we know more about our self than about others. Perception of one self is one more theory about the way things are (Gopnik 1993). What do we really know of conscious experience and how can we investigate it? Although introspection has been largely discredited as a method of psychological investigation, and some aspects of conscious experience are probed better with behavioral techniques, when it comes to the hard question I can see no other choice but to turn to introspection. To avoid naive reports based on subject's misconceptions rather than real observations one should learn how to watch natural mental events in an objective way, without ego-created interference. This is precisely what is done in meditative schools, especially of Buddhist origin,such as the Vipassana school of South-East Asia, Chan school of China or Zen school of Japan, schools that claimed "a special transmittion, beyond words, from mind to mind". This tradition has continuously been maintained for at least 2500 years and even today there are tens of thousands of sincere people practicing hard meditative techniques leading them to the mind states which are subjectively associated with greater consciousness, or stronger feeling of being conscious.

Looking for phenomenology of consciousness one should turn to the Abhidharma, the early Buddhist psychology. It is the most detailed analysis of conscious experiences that has been made so far. It is not based on speculations but on logical analysis of mental observations and has been repeated by many independent people. In Vipassana one observes the thoughts and other mental events impartially, without holding to them, just noting their appearance. If it is possible to clear misunderstandings about consciousness through introspection at all one should seriously listen to experts in Zen and Vipassana meditation techniques, people that spent many years observing their minds. So what do they have to say about consciousness? The results of this investigation were summarized more than 1600 years ago in the "Heart of perfect wisdom", the holy text of the Mahayana Buddhism tradition, to this day repeated every day by millions of Buddhists (quoted after Kapleau 1980):

Form here is only emptiness,
emptiness only form.
Form is no other than emptiness,
emptiness no other than form.
Feeling, thought and choice, consciousness itself
are the same as this.

How should we understand this quotation? From Western perspective translation of the Sanskrit word “sunjata" as “emptiness" is problematic: a better word (Wilber 1985) would be “unboundedness" or “inter-relatedness". Mind events, when reflected upon in details, dissolve into features and than into emptiness or unboundedness – form here (in the focused state of mind) is only emptiness. From this emptiness all mind events are constructed. A good analogy is provided by the microscope: matter dissolves into atoms finally into emptiness under very high magnification. The same is true for feelings, thoughts, choice (acts of volition) and consciousness itself. The answer of the introspection masters repeatedly stated since ancient times is: the self is just the sounds, sights and thoughts. The meaning is found at the level of total integration of the mind and body - the features of the mind events cannot be decomposed into the separate sensory/motoric and abstract thought components. Hard problem is an illusion.

There are many myth surrounding consciousness and one of them is that when we wake up we are continuously conscious. The familiar example against such a view, quoted in many papers, is that driving a car we are frequently not conscious of familiar surroundings and seem to wake up from this dream-like state when we stop. Some authors (Gray 1995) claim that even in such a state we may have been conscious but simply do not remember. This is one of the myth: we are conscious and this is continuing all the time during our waking hours. Anyone who has tried to maintain the feeling of being conscious for a few minutes, for example by watching the breathing or counting to ten (basic exercises in Zen meditation) without loosing awareness of the act, knows how hard it is to maintain it. We are rarely conscious, we rather have moments of consciousness, this special feeling of being alive and knowing it. By practicing mindfulness meditation people learn to be conscious of all perceptions and mental events. Practicing for many years they learn to enhance and maintain this feeling for longer and longer periods. The result of such practice is summarized in the Sanskrit expression: “Sat-Chit-Ananda", or being-consciousness-bliss, spontaneous feelings of bliss comes from consciousness of being. In the Western academic tradition Transpersonal Psychology (Wilber *et.al* 1989) has been established to deal with experiences of such kind. Various states of consciousness, their pathologies and transformations have been described by transpersonal psychologists in some details. This is the beginning of “science of consciousness" Penrose (1994) calls for, unexpected, but at least going in the direction of personal experience that is totally ignored by formal approaches.

To summarize this section: conscious experience should be treated on the same footing as feelings or thoughts, as subjective experience, something qualitatively different from theories about it. What is then subjective experience and can computers have it?

2 Brain and mind - two sides of the same reality

Some authors (cf. Gray 1995) make sharp distinction between primary and reflective consciousness. Primary consciousness is simpler and involves walking awareness of the sensory stimuli. The problem in this case is to determine why certain phenomena lead to experiences that are reported as conscious while other phenomena are processed sub-consciously by the brain. Stated in this way the problem becomes technical and should be addressed by brain scientists. However, it is reportability of experiences that is investigated, not the hard question of consciousness. Reflective consciousness is related to the self-reflection and involves the concept of “I" or “myself". This distinction is rather artificial as the “self" is always involved in conscious perception as a sort of background to all that we perceive (perhaps with the exception of some meditative states, cf. Wilber *et.al* 1989).

This particular feeling that we usually label “I see", or "I am" is at the root of the consciousness riddle. To label experiences we do not have to be conscious – optical character recognition software labels the visual experiences of a scanner attached to the computer. So why are we conscious and why do we have particular feelings - qualia - related to being conscious? First, what are feelings? As William James (1890) has already noticed:

If we fancy some strong emotion and than abstract from our consciousness of it all the feelings

> of its bodily symptoms, we find we have nothing left behind, no “mind stuff" out of which emotion can be constituted, and that a cold and neutral state of intellectual perception is all that remains.

Philosophers are careful to distinguish expression of emotion - something that can be behaviorally observed - from subjective feeling of emotion. More and more evidence has been accumulated (Damasio 1994, Varela *et.al* 1991, Johnson 1987) that this distinction is false and that James was right. Feelings are more subtle reactions than primary emotional responses, such as fear, nevertheless they are specific brain states. Conscious, subjective experience is not different. In naturalistic view the hard problem is just an illusion. Does it mean that all mental life is reducible to neurophysiological brain events? In principle yes, but only in the same sense as biology in principle is reducible to chemistry and chemistry reducible to physics. In practice we are far from reducing phenomenology of biology to chemical interactions. Interesting, complex phenomena require their own phenomenology and our goal may be at most to find the link between psychological concepts and neurobiological brain structures, not to reduce psychology to neurosciences. Simple reductionism is certainly not satisfactory.

Conscious feeling - as all feelings - cannot be reduced to some logical or symbolic processes, to changing the potentials or synaptic conductivities in the brain. Only a small part of biology is due to the biochemistry, the structure and behavior of the living organisms that we have at present is a result of evolution and cannot be decoupled from the evolution of the whole Earth, solar system, ultimately the Universe. My conscious feelings come from particular states of the whole mind/body system, from close associations of the concepts “I, me" with activations of the subcortical brain structures, hormone system, in fact the whole body that cannot be separated from the environment and the evolution of the Universe. Excitations of my mind are physicochemical processes, but it is not possible to understand them as such any more than its possible to understand biology through biochemistry. My brain/mind states depend on the content of my inner world, on something too subtle to investigate at the physical level only. It is impossible to talk about mind events in terms of computational processes of neural hardware, as it is impossible to talk about properties of the liquid water in terms of properties of the hydrogen and oxygen gases or even properties of the individual molecules of water. Cooperative properties in interacting systems are always qualitatively different from properties of the constituents - they have emergent qualities. It is not surprising that specific interactions of a large number of neurons give rise to qualitatively new properties. There is nothing strange in the emergence of the higher cognitive functions from the complexity of the brain. At each level of description an appropriate language and theory should be used. The flow of water in a river is described by hydrodynamics, the theory that uses specific concepts that cannot be directly derived from quantum mechanics. It is impossible to speak about mental events using directly the language of neural events as it is impossible to speak about turbulence in quantum mechanical terms.

Although the mind states are inseparable from the brain states to understand the flow of my mind states one needs to know my history, the structure of my mind rather than the structure of my brain. An appropriate language is needed for cognitive sciences. Mind events are given by direct experience while the existence of all other events is inferred from this experience by reasoning. Therefore cognitive science has to be based on mind events and has to connect these mind events with the computational processes in the brain (Duch 1996). There are two sides to the mind-body problem. Inspired by reductionist approach, neuroscientist look for causes of behavior into the brain and are quite successful in explaining specific cognitive deficiences as well as some psychiatric illnesses. In this view mind states follow brain states. On the other hand psychologist and psychotherapists try to understand the behavior in purely psychological terms. In this view brain states follow mind states. Both points of view are different approximations to the very complex process of mind/brain creation and evolution. Both are valid points of view and should be used whenever they are effective. What is urgently needed is some common language bridging these two points of view.

To talk about consciousness without falling into unfertile reductionist soil we need a language that is more specific than folk psychology. Is it possible to answer such question as “what is consciousness" in a satisfactory way? Ultimately we may only explain what is the structure of the mind, as we can explain what is the structure of the matter, even though we cannot define what the matter is. In physics we use with great success concepts such as energy, space or time, concepts that are not reducible to simpler concepts. The meaning of fundamental concepts should be grounded in direct common sensory experiences, not in other symbols. The vicious circle of self-referential definitions is stopped by pointing directly to real events. What is the taste of chocolate? Only

when you taste it you will know. Qualia that we have seeing red color obviously depend on our past experiences: do we associate red with sunsets or blood, pleasant or unpleasant things. Such feelings are subjective, subtle and hard to investigate by brain science but they are specific brain states as much as other brain events. One has to be careful not to think naively that it means that exactly the same sequence of physical states has to be repeated in all brains (or even the same brain at different times) - neural systems do not work in a repeatable way like digital computers (cf. Freeman 1995).

A meaningful language to describe mind events is needed. It should allow for more precise description and should lead to models of the mind that can be tested in experiments and computer simulations. The language should be extendable but at the initial stage it should only cover the basic features of the mind, in a similar way as the mathematical language of classical physics allowed to describe planetary motions and other simple physical systems. The “time" of classical physics has little to do with the perception of time and yet proved to be a very useful concept. In the same way we should define a set of simple, useful concepts that will allow for more precise description of mind events (Duch 1994). In a sense this is a step towards a Platonic vision of mind, treating the mind seriously. In the Platonic world only abstract concepts are real, represented by symbols. Since language is based on linear sequences of symbols we tend to think that minds work by symbol manipulation. Two-years old children may not yet use symbols and yet their minds are already quite complex. What are the real mind events made from? They are composed primarily from the preprocessed sensory data and are mostly recognitions, recollections and memorizations. The preprocessing stage of sensory information is very important and much of the research in cognition is devoted to understanding how the low-level cognitive stages operate. Direct sensory perceptions and iconic memories of past experiences form primary mind objects, while secondary, more abstract objects acquire their meaning through their relations with the primary objects. Once a primary object, an experience involving bodily sensations as well as the internal mind states, is committed to the long-term memory it can be recalled back and the experience reinstated. Some mind objects, even though conventionally designated by a single symbol, are very complex. They should be treated rather as a collection of interrelated simpler objects, occupying relatively large volume of the mind space, than as a single object. Probably the representation of the cognitive system itself, referred to as “myself", is the most complex of all mind objects. These are technical matters that I do not have time to discuss here (Duch 1994, 1996).

3 Consciousness, information processing and physical states

Why is it not possible to know by learning? Chalmers (1995a) describes the thought experiment in which Mary, neurobiologist of the XXII century, learns all about experiences of color although she herself cannot perceive red color. Knowing all that it is possible to know she still does not know how does it feel to see red.

Is this really surprising? Mind states and brain states are just two ways of looking at the same reality. Brain states related to thinking and learning involve mostly frontal and left temporal lobe while visual experiences involve occipital cortex. Of course arousal of temporal and frontal lobe cannot replace arousal of occipital lobe. I can share my experiences only with those beings that have brains that are able to be in similar physical states as mine. To the degree we share the same brain states we may share also mind states. I cannot share many mental experiences with bats (Nagel 1980) since I lack their brain structures. It is not just that the information is processed in a different way, but the physical states of their brain are quite different.

It is interesting that in the discussion following Searle’s Chinese Room thought experiment (Searle, 1980) no one has objected to the very idea of such an experiment. How can I know that other people or artificial devices perceive meaning? Certainly not by looking into their heads and placing there some demon that watches the inputs and probes for understanding. Where could we put such a demon in a human head? In each neuron or synapse? In this way we would not be able to determine that other people are conscious. All we can do is to “resonate" with them (there is some wisdom in folk psychology), and since we have the same brain structures we may have similar feelings and experiences. I will try to invert the thought experiment of Searle - this time I’m going to realize formal program using my brain. Suppose that I find myself in a remote monastery in Tibet where a group of monks try to communicate to me philosophical concepts in a language I do not understand. One of the traditions there is to lead complex dialogs – called Dharma combats – on intricate philosophical

issues. Suppose that I'm trained by them to respond to the sounds that I hear by producing others sounds. After years of such training I am able to lead discussions although I still do not understand a word of what is being said by me and my opponent. One day, however, I get hold of the dictionary and learn the meaning of the words. Now I can not only respond, but also understand what am I saying. What has changed in my brain? Without understanding only a part of neocortex (mostly frontal and temporal lobes) was engaged. When I have learned the meanings of the words the sounds became associated with experiences and the whole neocortex as well as many subcortical brain structures (strongly coupled to the rest of the body) became involved. There is a big difference between understanding and just instantiating a formal program of responses. The moment I begin to suspect that the sound I hear in a foreign language may mean something my whole behavior changes – I have qualia associated with the sound.

Can artificial devices have any experiences at all? Searle thinks that electronic devices lack some mystical casual powers of neurons, and therefore they obey only syntactic rules and have no semantics. Human brains are in real physical states. Feelings start at cellular level with each cell signalling to others, trying to survive. This is not what is captured by artificial intelligence. Real understanding of human affairs requires human body and individual history of brain states, not just feeding information. Are computer electronic chips approximating real physical brain states? Even massively parallel computers have nothing to do with it, all that is approximated is the flow of information in the brain. Why should it bring the same physical states? We do not have any evidence that it is possible to separate human mind from the brain.

No computer program by itself is sufficient for intentionality, but information processing may be sufficient for real intelligence. Already now there are many programs solving nonalgorithmic problems better than humans are able to. Intelligence is the ability to use knowledge (Newell 1990) and from this point of view artificial intelligence (AI) is developing quite well. General intelligence that humans have requires vast computational resources. If we compare the complexity of brains and computers it is actually amazing how intelligent artificial systems already became. Experiences are real physical states, information processing is an abstract computation. From this point of view consciousness appears to be an irreducible property of brains or other devices that may assume states of similar complexity. consciousness of the human type is possible because of the brains we have. Chimpanzees have brains that are about one third of ours and that already seems to be sufficient to exhibit some mind states. Apes have smaller brains and seem to be further from our experiences. Among humans we may also find cases with microcephalia or hydrocephalia that allows only for simplest forms of conscious experiences. It is enough to cool our brain to observe how conscious reactions slow down, become dull, finally only short flashes of consciousness remain before the whole experience vanishes completely.

A good question seems to be: how well can we approximate real brain states using silicon devices? If an approximation is perfect the results must be perfect too, i.e. we should get a system responding like a real mind. I doubt that such devices could be described by Turing machines. Real physical processes belong to different ontological category than abstract computations. In principle it should be possible to build something like a brain using silicon devices but it will not be a digital computer. On the other hand treating minds as knowledge processing systems and trying to make programs that process symbolic knowledge in a similar way may be a fruitful approach leading to artificial intelligence (Newell 1990). Strong version of AI claims - minds are programs, programs really understand and are like minds, while computers are like brains - is obviously false. Digital storm will not produce real rain, no matter how detailed the simulation is.

4 Towards a theory of consciousness

Consciousness is just one aspect of the mind. I will briefly summarize here my own phenomenological approach to consciousness.

Minds and brains are two aspects of the same complex evolving system strongly embedded in the environment. Some properties of this system result from individual development - in case of humans interaction of infants and children with their environment (Thelen and Smith 1994). Other properties result from the evolution of our species, a history which cannot be separated from the evolution of the Earth, climatic changes, perhaps

random events in the distant past. Brains give rise to mind and vice versa, minds determine the structure of brains. Thoughts and emotional reactions can literally change the structure of the brain influencing neurochemical processes (Black 1994). The structure of our minds is based on subjective experiences - what else can we remember but the states of our own mind/body? Conscious experience is a specific brain/body state characteristic to complex brains. Such experiences allow for more flexible modification of behavior and are necessary for intelligence.

Lesions have taught us a lot about localization of various mental functions but consciousness is much more robust than such cognitive abilities as recognition of words or faces. Destruction of several regions of the brain, notably RAS (reticular formation of the brain stem) and ILC (intralaminar complex of the thalamus), induces coma (Gray 1995). Extensive damage of subcortical structures may lead to complete alterations of conscious experience. Many drugs produce also various changes in conscious experience, from enhancing certain qualia to producing a zombie-like state. Since conscious experience does not depend on localizable neural tissue a number of cortical and subcortical structures have to be involved to generate it. A consensus slowly develops among neuroscientists as to which brain structures have to be active for the conscious experience to arise - they comprise the ERTAS system (Extended Reticulo-Thalamic Activation System). Consciousness is a particularly difficult subject to study because experiments on animals are of limited usefulness and there is little data relating human conscious experience to brain damages. We cannot cut off all memories of things red and then see how it will influence the qualia of looking at the red color. In addition, as Freeman (1995) has shown, the same stimulus and the same behavior do not imply similar neural activity. The approximately invariant entrainment of smaller groups of neurons may be embedded in chaotic activity of larger neuronal groups and therefore could be difficult to find. It is not just the activity or lack thereof, but also the proper synchronization of activities (entrainment) of several brain structures that is important for conscious experience.

What are the necessary conditions for conscious experience? Conscious experiences connected with the sensory inputs or perception of thought processes happen in the time scale of the tenth of a second (Dennet 1991). Shorter stimuli may have an impact on the subconscious processes and be perceived in the subluminal way influencing behavior but they “do not make it" to the consciousness. It means that we not only do not remember perceiving them but also that they have not influenced the ERTAS system strongly enough to create conscious feeling. Conscious perceptions is relatively slow comparing to many other processes in the human organism and nervous system. In Libet’s (1993) experiments transition from unconscious to conscious experience was a function of duration of the stimulus and for durations that are too short there is no conscious experience. It is also a function of the strength of the stimuli. It is quite understandable: it takes energy to activate the ERTAS system and time is needed to transfer the energy, like in any electrical circuit. In Libet’s experiments the stimuli were simple electrical stimulations of the human somatosensory cortex. For low intensity electrical impulses, at the threshold of invoking the conscious experience, 500 milliseconds stimulation is necessary, shorter stimulations do not create conscious experience. Readiness potentials appear in the motoric cortex about 550 ms before the intended action, while subjectively felt intention is reported about 200 ms before the action. Moreover, perception of the order of events in the time frame of 500 ms may actually become reversed. From these experiments it is clear that conscious feeling - slow activation of the ERTAS system - arises after the brain takes the decision and starts their execution (Duch 1995). There is no evidence that human information processing is conscious (Velmans 1991).

The relatively long time of the order of 0.5 sec needed to invoke conscious reactions results from the time needed to form stable patterns of neural excitations in relatively large ERTAS loop. There is much noise in the brain, neurons are not reliable elements and to be a robust controller of the body the brain cannot allow reactions to short transition patterns of neural excitations. This is a basic requirement of the evolution and comes from the optimization of time scales needed for fast information processing in dangerous situations and minimization of energy consumption by the brain. Neurons communicate by sending spikes of impulses, in the inactive state rather slowly and in the excited state more frequently. The main parameter carring information in the brain is the average frequency of spiking. It is simply impossible to avoid noise in the brain and yet our conscious experiences are coherent and stable. In artificial neural networks controlled noise is frequently added to the input data to obtain more robust adaptation, smooth the irregular data and solve hard optimization problems. In effect networks learn prototypes rather than exactly the data presented, and meaningful generalization becomes possible. What counts as a recognition in recurrent neural network is a stable state, not the short transition

states that do not carry any information. In the real brain also only stable patterns of excitations are important and carry information therefore conscious experiences should be connected only with such stable patterns.

Formation of such stable patterns of excitation in the dynamical system in which noise is important is a slow process. Another factor contributing to the slowness of this process is connected with the nature of human experience and the construction of the brain. Specialized areas of the brain analyze different features of sensory experiences to compress the amount of information that reaches the high-level ERTAS feedback loops and becomes conscious experience. Compression of information is a very general and important mechanism used by the brain. The results of analysis by various low level feature detectors are bound together in one perceptual object. For example, in the visual system alone there are five separate areas analyzing colors, shapes and motion. Damage to one of these areas may selectively remove some features of conscious experience; damage to all areas except for color was observed, leading to a very strange conscious experience: whenever the eyes fell on at a given moment only color was perceived. Signals from different low-level perception areas are bound together via long axons of the transcortical neural cell assemblies (TNCAs). Creation of the stable patterns of activities in such a large brain areas require times of the order of at least tenth of a second. Episodic memory feedback between the percept represented by a particular structure of ERTAS excitation is formed and the specific state of the mind/body remembered as “an experience".

Such theory may be empirically tested and applied to explanation of many cognitive deficits. For example patients with some parts of visual cortex damaged loose conscious visual perception but they still may react correctly (at least above the chance level) to visual stimuli. Such blind sight phenomena are a zombie-like behavior: acting without consciously knowing why. The brain may process information without activating the ERTAS loop responsible for conscious feeling. We can indeed imagine a zombie, a person that seems to be normal and yet acts in an automatic way, not conscious of his/her action. Such condition of being a zombie (Dennet 1991) may be created by some special drugs used during Voodo ceremonies. Probably these drugs prevent the activation of the ERTAS system, necessary to experience qualia, i.e. to evoke particular states of the mind/body. Such zombie experiences do not feel like anything it is like to be. Perceptual illusions, such as masking or Soostrop effect (Dennent 1991) are more fertile ground for empirical predictions. These are rather technical matters, therefore I’ll turn now to fundamental problems.

Obviously in naturalistic approach mind body problem does not exist since mind and body are just to different ways of looking at the same complex system. How can a state of mind, such as a “low gas" observation, lead to an intentional, physical action? If the mind is in the state represented by the “low gas" idea the next probable train of mind states (only probable, because many factors may push the next state of mind in another direction) is “car will stop" and “look for the gas station". These ideas (mind objects) are accumulated in the learning process and once they are activated they may influence the ERTAS system and generate a conscious feeling at the same time (or even fractions of a second earlier) influencing the motoric actions. The brain processes (or other hardware processes) have to follow this particular entrainment of ideas (mind objects) because stable patterns of neural excitations correspond to the ideas that are entrained. These ideas are close to each other in the mind space - i.e. transition probabilities between these ideas represented as abstract objects in psychological space are high) and at the hardware (brain) level corresponding attractors in the recurrent neural network (Amit 1989) are close to each other. My belief, via the entrainment of ideas, leads to a series of states of mind. Since each state is grounded in the kinesthetic image and sensoro-motoric schemes it has direct influence on hardware actions - the “mind over matter" mechanism is quite simple. On the other hand any disturbance in the natural functioning of the neural hardware (especially at the level of neurotransmitters in the brain) will strongly influence the dynamics of the mind states and thus experiences of the system.

The symbol grounding problem (Harnad 1990) - how do the symbols acquire real meaning - is connected with the problem of qualia. Each mind object, something that is a specific activation of the ERTAS system generating conscious feeling, is composed from a combination of many features of internal representation. An activation of the system is done using a subset of these features. Conscious experience - recognition - activates similar memory traces associated with the perception. Experiences are revoked, with vividity dependent on the strength of the back-coupling with the secondary and primary sensory areas. What do I mean by “sweet"? Something sweet! The system, like an old Zen master hitting with his stick, points directly at the sensory experiences as the ultimate source of grounding the mind in reality. The symbol grounding problem arises only in formal systems,

when the linguistic labels are separated from other qualities of the perceptual objects. Brain/mind is not a formal information processing system. There is no need to ground symbols in experiences since experience come before symbols. We learn to label experiences. The label “sweet" corresponds to a projection of all sensations, all memories that we have associated with it. The existence of qualia has observable consequences: the probability of the next mind state obviously depends on them. From the sensation “sweet" memories of things sweet spring up. The problem of the mental content is a particular form of the qualia problem connected with the mental objects. Thoughts must be about something since they are activations of mind objects containing reified experiences, are non-decomposable mixtures of many features of representation. Cognitive systems must have subjective states which results from their past experiences.

Symbol processing systems cannot reach real understanding, even if they could pass the Turing test (I doubt that it is possible) or solve the frame problem (Harnad 1993). Qualia are not present in the Chinese Room example of Searle (cf. Hofstadter and Dennet 1981), since real understanding and qualia come from real brain states. Thermostats and other simple systems do not experience qualia (Searle 1980) - even humans, when their brains do not function properly, do not experience qualia. In short, the root of the mind-body and related problems in philosophy of mind lies in the attempt to use a wrong language for description of mind events, language based on a separation of the linguistic labels from the real mind objects. There is no way of human communication that could refer to mind objects directly. We are fooled by the use of language, of verbalization distorting the totality of our experience: words are like Platonic shadows on the wall, linearized descriptions that cannot do full justice to the multidimensional reality. We are inventing more words, increasing the number of linguistic dimensions, but still we deal only with the shadows.

REFERENCES

Amit D.J, (1989) Modeling Brain Function. The word of attractor neural networks. (Cambridge University Press, UK)

Black I.B (1994) Information in the Brain. A Molecular Perspective (A Bradford Book)

Chalmers D.J. (1995) Facing Up to the Problem of Consciousness. Journal of Consciousness Studies 2: 200-219

Chalmers D.J. (1995a) The Puzzle of Conscious Experience. Scientific American, Dec. 1995

Damasio A.R. (1994) Descartes’ Error: Emotion, Reason and the Human Brain (Papermac/MacMillian, London)

De Mello, A (1985) One minute Wisdom (Gujarat Sahita Prakash, Anand, India)

Dennett, D.C. (1991) Consciousness explained (Little Brown, Boston)

Duch W. (1994). A solution to fundamental problems of cognitive sciences. International Philosophical Preprint Exchange.

Duch W (1995) Physics of consciousness. IV Krajowa konferencja “Modelowanie Systemów biologicznych", Kraków 2-3.06.1995, pp. 101-114

Duch W (1996) Computational physics of the mind. Computer Physics Communications 97: 136-153

Eccles J.C. (1994) How the self controls its brain (Springer Verlag, Berlin)

Freeman W.J. (1995) Societies of Brains: A study in the neuroscience of love and hate (Lawrence Erlbaum Associates, New York)

Gopnik A (1993) How do we know our minds: The illusion of first-person knowledge of intentionality. Behav-

ioral and Brain Sciences 16: 1

Gray J.A. (1995) "The contents of consciousness: a neuropsychological conjecture", Behavioral and Brain Sciences 18: 659-722

Harnad, S. (1990) The symbol grounding problem. Physica D 42: 335-346

Harnad, S. (1993) Problems, problems: the frame problem as a symptom of the symbol grounding problem. PSYCOLOQUY 4 (34) frame-problem.11

Hofstadter, D.R, Dennett, D.C. (1981) The mind's I (Basic Books, New York)

James W (1890) The Principles of Psychology, Vol. 2 (New York, Dover, 1950)

Johnson, M. (1987). The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason. Chicago: The University of Chicago Press.

Kapleau P. (1980) Zen. Dawn in the West (Anchor Press/Doubleday, New York)

Libet Benjamin (1993) Neurophysiology of Consciousness. Collected papers and new essays (Birkhäuser, Boston, Basel Berlin)

Nagel T (1974) What it is like to be a bat. Philosophical Review 4: 435-450

Newell A (1990) Unified theories of cognition (Harvard University Press, Cambridge, Massachusetts)

Ni Hua-Ching (1979) The complete works of Lao Tzu (College of Tao and Traditional Chinese Healing, Los Angeles)

Penrose, R. (1989) The Emperor's new mind (Oxford University Press)

Penrose, R. (1994) Shadows of the Mind: a search for the missing science of consciousness (Oxford University Press)

Searle J.R. (1980) Minds, Brains and Programs. Behavioral and Brain Sciences 3: 417-457

Stapp H.P. (1993) Mind, matter and quantum mechanics (Springer Verlag, Heidelberg)

Thelen E. and Smith L.B. (1994) A dynamic systems approach to the development of cognition and action. (Bradford Book 1994)

Varela F.J, Thompson E, Rosch E. (1991) The embodied mind. Cognitive science and human experience (MIT Press, Bradford Books)

Velmans M (1991) Is human information processing conscious? Behavioral and Brain Sciences 14: 651-726

Wilber, K. (1985) No boundary. Eastern and Western approaches to personal growth. (Shambala: Boston & London)

Wilber, K, Engler J. and Brown D.P. (1986) Transformations of consciousness. (Shambala: Boston & London)