Emulators, representations and Descartes' ghost

MIHAI VACARIU and GABRIEL VACARIU

Abstract

Within the framework of epistemologically different worlds, we analyze Grush's emulators (a return to the Cartesian framework that avoids the substantial dualism) and Wheeler's approach of Descartes. Postulating the existence of one unique world, what we call the universe, cognitive scientists and philosophers are continuously compelled to invent all sorts of Ptolemaic epicycles for solving problems in explaining human cognition and its functions. Grush's emulators become unnecessary if we replace the framework of unique world with epistemologically different worlds.

1. The Epistemologically Different Worlds (EDWs)

The EDWs perspective is an alternative framework in which fundamental problems from philosophy (mind-body problem and all its related problems from philosophy of mind and cognitive science[1]) and science (the field of quantum mechanics with its problematical notions like entanglement, nonseparability, the relationship between micro and macro-"levels", etc.) could be analyzed and catalogued as pseudo-problems. From a broader perspective such EDWs, these sorts of problems have no sense because we give up of the notion "world" or "universe", what Gabriel Vacariu has called the "unicorn-world" (Vacariu 2005).

There are six main principles that define the EDWs perspective[2]:

(P1) Under different conditions of observation, the human subject observes epistemologically different worlds.

(P2) The determining epistemologically different entities and their corresponding constitutive epistemologically different interactions represent the epistemologically different worlds. Each epistemologically different world has the same objective reality.

(P3) As human attention is a serial process, the human subject cannot simultaneously observe EDWs.

(P4) The set of judgments that describe the phenomena of each epistemological world must follow the rule of conceptual containment that is given by the conditions and limitations within the concepts of the judgments. These conditions and limitations are governed by the properties of (internal or .external) tools of observation.

(P5) In physical terms, the part-counterpart relation corresponds to the "I" or human subjectivity or experience.

(P6) The "I" is knowledge

[1] We emphasize here that all the particular problems from philosophy of mind and cognitive science cannot be completely solved if the main problem – the mind-body problem – remains unsolved! It is not the consciousness problem, as Chalmers underlines in various papers, the central problem of these fields but the Cartesian mind-brain relationship. We have to solve firstly the mind-brain problem, the human subjectivity and then the consciousness problem.

[2] The full argumentation of the EDWs perspective are detailed in Vacariu (2005).

With this set of assumptions that circumscribe the EDWs perspective, we can analyze various issues in cognitive science/philosophy of mind in order to see whether these are real issues or, within the new framework, they are just pseudo-problems.

2. Grush's new Cartesian framework

Rick Grush has elaborated and further developed a so-called theory of emulation, an approach that assumes some Cartesian ideas (or properties of mind, such as the existence of representations[3]), but at the same time, rejects Descartes' ontological dualism. Even if Grush's approach is not a full Cartesian alternative, there have been some voices warning us about the possible appearance of a new Cartesian framework (Clark 2008, 7.5; 7.6 and Chemero 2008, 3.4.2). However, for Clark, this new Cartesian framework is not a re-creation of the old Descartes' approach (apart from dualism, the existence of the "I" which exists because of its fundamental property thinking), but a kind of cognitivism (computationalism) according to which all thoughts and other cognitive actions are happening "inside the bounds of skin and skull." (Clark, 2008, p. 154, footnote 11; or p. 245) In short, Grush's emulator's theory claims that the *emulators* are parts of the brain that "act as model of the body and environment" (Grush 2004, p. 307). A particular part of the brain, the control area[4], sends commands to body for interacting with the environment. At the same time, the control area sends the same commands to the emulators. The emulator sends back this information to the control area. Important is that the "efference copies" of the brain (that reflect the interactions between the body and environment) run in parallel. These copies are the emulators.

Now, the question is why Grush needs to postulate the existence of such emulators for explaining human cognition? They are necessary, in his opinion, to provide the "expectations of the sensory feedback", to "estimate the outcomes of different actions", or to "evaluate and develop motor plans." Also, the emulators are the "inner models running in parallel with the body can reduce the effects of feedback delay problems"[5] (Grush 2004). Thus, the emulators have these sorts of 'magic' functions and they seem very useful in explaining particularly the motor and perceptual mechanisms. However, within the more general framework of the unicorn-world, it should not be surprising that cognitive scientists and philosophers cannot explain the cognitive functions. If it is to have a look from above at the entire picture the fact that Grush postulates the existence of the emulators could be regarded as a sort of Ptolemaic epicycles, that is, Grush, like a lot of other cognitive scientists thinking within a particular framework, namely, the uni-corn world, needs to postulate the existence of various entities in order to explain functions that are 'visible' in our world. However, the real issue here it might be precisely the general framework in which the scientist are thinking, that is, the fundamental assumption that everything,

[3] Against van Gelder's interpretation of the Watt governor, Grush pleads for the existence of representations status of his emulators "since they are not coupled to the systems they represent. The brain can silently contemplate, dream, plan, all as a matter of a play of representations – pretty much everything Descartes thought the mind could do even in absence of the world." (Grush 2003, p. 87)

[4] For describing these processes, Grush uses complicated tools from the control theory and signal processing (pseudo-closed-loop control and Kalman filtering).

[5] In the abstract of Grush's paper from 2003: "(…) the brain constructs inner dynamical models, or emulators, of the body and environment which are used in parallel with the body and environment to enhance motor control and perception and to provide faster feedback during motor processes, and can be run off-line to produce imagery and evaluate sensorimotor counterfactuals." (Grush 2003, p. 53)

from atoms, cells and neurons to humans and stars, altogether with their functions, exist in one single and unitary world.

Let us analyze the role of the motor emulator: the "actual motor outputs" are inhibited, while the motor emulator works with "virtual sensory inputs" and "virtual feedback signals" (Grush 2004). Thus, the motor emulator, in fact, "*replicates*" the parts of the musculoskeletal system and their movement. Now, the question is what does "replicate" means in this context? Do we need a sort of a homunculus to explain these concepts, even if the motor emulator is part of the brain? Or "replicate" means that the high-level neurons replicates the low-level which is activated either by the external signals or by the internal commands of the control area? It looks like the emulator theory, in order to be functional, needs a neural homunculus that controls at least the motor and the perceptual mechanisms.

If the above approach could be applied to sensoriomotor systems, then it should work with the conceptual mechanisms as well. However, in both cases, "representations" are essential: a cognitive system needs representations that are "surrogates that can be decoupled and run offline". (Clark 2008, p. 152) To explain the functions of emulators, Grush would probably need a "surrogate body" inside of the mind, if we think for example of explaining the error movements[6]. Within the framework of the unicorn-world, which is based on the identity theory, these sorts of functions cannot be explained. However, from an EDWs perspective, the brain and the body are embodied within the environment, but the "I" (that corresponds to the brain and the body) is an epistemological world (EW), so the "I" does not interact with the external environment. The idea is that it is meaningless to consider the interactions between EDWs. The "surrogate body" exists but this and all the other mental states and processes are the "I". We need to replace "emulators" and "surrogates" with "correspondences". The postulation of emulators was indeed necessary in order to explain some of the cognitive functions within the framework of the unicorn-world. The main difference between the emulation theory and the EDWs perspective is that the emulators are parts of the brain, while within the EDWs perspective, the mind and the brain are epistemologically different worlds. Even if one considers that the mind-EW is a sort of an emulator for the brain's activities, there is still a huge difference between the two approaches, just because the mind and the brain are entities that belong to epistemologically different worlds.

It is notable that Grush emphasizes that he is not "making the outrageous claim that the brain is *nothing but* a big emulator system." (Grush 2004, p. 389) As the emulators, which are parts of the brain, copy the actions of other parts of the brain and the body, it is obvious that the brain could not be a big emulator. From an EDWs perspective, there is only a *correspondence* between the mind-EW (its entities and processes) and the brain-EW (its entities and processes). The mind-EW does not emulate/copy the brain's processes. Again, from our viewpoint, these emulators are a kind of mechanization or materialization of homunculus. Homunculus is replaced with a set of neural emulators that copies the body's actions and the external environment. Homunculus entails representations and other Cartesian and computationalist characteristics. Therefore, Grush (2003) officially adopts a restricted Cartesian framework, restricted just because the emulators are parts of the brain not

[6] About "surrogate", see Waxman interpretation on Kant's transcendentalism (1995) and Vacariu (2008) – the principle of knowledge (the "I" is knowledge) in which the representations that correspond parts of the bodies and external environment are such surrogates that constitute the self.

parts of another ontological substance, the mind.[7] Clark has an objection here: we have a fight between a kind of functionalism which leads us to the "extended mind" and a pseudo-Cartesian framework which preserves the mind inside the bounds of skin and skull. Grush defines the mind in the following way:

> … the mind is not essentially a thinking or representing thing: it is a controller, a regulator, an element in a swarm of mutually causally interacting elements that includes the body and environment whose net effect is adaptive behavior. And it is not autonomous: the mind/brain is essentially bound up with both the body and environment to such a degree that, unless all one is interested in is neuroanatomy, singling the brain out for independent study is a mistake. (Grush 2003, p. 55)

Grush's emulation theory and his definition of mind are ingenious constructions through he tries to solve in fact some pseudo-problems within the unicorn world. For Grush, the mind is a regulator because it is necessary a mechanism (not a central processor) that regulates the behavior in a changing environment. However, if we replace the emulators (or better, Grush's notion of mind) with the "I", as an EW, we can eliminate the Ptolemaic epicycle constructed within the unicorn-world.

As Grush wants to keep certain Cartesian assumptions (mainly the existence of mental representations and computations), he has to be against the dynamical systems approach (and its correlates, the embedded/embodied cognition approach). He disagrees with the idea of anti-representationalism which is a fundamental assumption of the dynamical systems approach. Without representations, the emulators cannot accomplish their functions.Grush's theory regards mainly the sensoriomotor system which implies interactions between the three entities: brain, body and environment. According to him,

> … the emulator represents objects and the environment *as things engaged with* in certain ways as opposed to how they are considered apart from their role in the organism's environmental engagements. The perceived environment is the environment as made manifest through the organism's engagements, because the emulator that supplies the perceptual interpretation is an emulator of the agent/environment interactions. The conceptual significance of this is that it allows us to acknowledge the action/behavioral bias of perception without becoming anti-representationalist about perception. (Grush 2004, p. 393, his italics)

In another place Grush says:

> On the emulation framework, emulators are constructed and maintained in order to be able to stand in for the body/environment. But they don't simply represent the world, but more specifically they represent the world *as interacted with by the organism*. Only those aspects of the body and environment that are manifest in the organism's engagements can be represented by the emulator, and only those that are salient for the organism need be. (Grush 2003, p. 88, his italics)

Grush wants to include in his theory the interactions between body and environment, so he assumes the existence of an *environment emulator* having the role of creating an "accurate estimate of the environment" (Grush 2004, p. 391). Let us explain one of the main ideas from Gursh's theory: many motor-perceptual functions would necessitate more time without the role of the emulators. As we saw above, the control area sends commands to body (in order to interact with the environment) and to the

[7] As we show in Vacariu (2008), the dualism and all the other alternatives are constructed within the unicorn-world.

emulators (that send backs this information to the control area). The emulators mirror the interactions between the body and environment for saving time. Thus, the control area can predict the next movement before to receive signals from the environment.

Now, how can we interpret this interesting idea from the EDWs perspective? Within the mind-EW framework, the "world is the self" (Waxman 1995), i.e., the mental representations and processes about the external world and the body (the "surrogate body") are the "I" or the mind-EW (see Vacariu 2008). The "I" (or the mind-EW) can predict not the movements of the body (the body belong to the macro-EW) but the "movements" of the "virtual" body that is the "I". This virtual "body" is the "surrogate body" mentioned above and corresponds to the real body. This means that there are mental representations for each part of the body and the body as a whole and all these mental representations are the "I". The virtual and the real bodies belong to EDWs. There are no interactions between this virtual body (the "I") and the environment just because these entities or "worlds" are/belong to EDWs. In a Kantian sense, the external environment (and the body) "are brought" within the self, i.e., the mental perceptions about the external world (and the body) are the "I". Thus, all the predictions necessary for the virtual body to move are parts of the "I". The "I" is knowledge, all kinds of knowledge acquired during development and daily experience of a subject. As it is showed in Vacariu (2008), this knowledge has a unity and based on the unity of this knowledge, the predictions are possible. Even if, from another side, within the macro-EW (or the brain-body-EW that is part of the macro-EW), the brain sends "commands" to the body for its movements, neural processes that correspond to mental commands, it is impossible for us to explain them within the brain-EW. Within this framework, we do not need emulators that copy the environment, a process that it is necessary for saving time.

It seems that the emulator theory is a kind of "surrogate" either for dualism (that is a materialization of Descartes' mind) or for computationalism (the homunculus). Even if Grush agrees with the identity theory, the emulators have a similar role as Descartes' mind[8] or an "*active*" homunculus. The emulators are very active in such interactions accomplishing their functions. Thus, we see a combination between Cartesian framework and computationalism (the mind and its representations), from one hand, and the dynamical system theory (the interactions between mind/brain, body and environment, on the other hand. Following Clark and Grush (1999), Grush claims that the cognitive systems combine two essential qualities: real-world coupling and internal representations (Clark and Grush 1999 in Clark 2008, p. 150). For Grush, an essential concept is the "motor emulator circuit" (Grush 2003; 2004). A copy of the current motor command is sent to an onboard circuit (the motor emulator) that replicates the dynamics of the musculoskeletal system. The emulator's output is a prediction of what the sensory feedback should be. This "virtual feedback signal" is used to correct errors in the systemic unfolding and can itself be compared (at a later moment) with the actual feedback arriving from the bodily parts for purposes of calibration and learning. (Clark 2008, p. 151)

We have to admit that, within the unicorn-world framework and in the context in which almost everybody rejects the Cartesian framework (the autonomy or separation of the mind from the body and environment), Grush's effort is remarkable. In this framework, entities like emulators, with that sort of functions, had to be postulated in order to explain the relationship between high- and low-levels (cognition

[8] See the title of Grush's article: "In Defence of Some 'Cartesian' assumptions Concerning the Brain and Its Operation" (2003).

and perception/motion). However, what we claim is that that sort of entity is not a particular emulator, but the "I", as an epistemological world (with all its functions and properties), and it is the "I" that *corresponds* to the interactions between the brain, the body and environment. It is much easier to explain the emulator's functions through the "I" (the mind-EW). If the "I" exists, then, there is no necessary a thing like an emulator, that is, something that emulates or copies some specific functions. The "I" alone (the implicit knowledge acquired during the experience) is able to predict, evaluate and develop the motor plans. And the "I" is not an emulator that receives input from the control system, in parallel with the musculoskeletal system.

According to Grush, an emulation architecture "is "necessarily part of a larger cognitive system that includes memory and executive processes" (Grush 2004, p. 390). We believe that essential and complex functions such as control system, memory, executive processes have to be "correlated" with very large parts of the brain but it is almost impossible to localize these functions in the brain! The musculoskeletal system is part of the body which is strongly interconnected with the brain[9]. Therefore, an emulator to accomplish its task would be practically the whole brain-body system. Or, it could be the "I" as an epistemological world. Within the EDWs framework, the emulators are useless. With the experience and the knowledge acquired in time, the "I" is able to fully accomplish the functions of an emulator. Again, we assert that the emulators are simply Ptolemaic epicycles, entities postulated within the unicorn-world framework, but unnecessary within the EDWs perspective. The bottom line of this argument is that we need a new paradigm, a new approach in cognitive science, that is, we need to replace the unicorn-world perspective with the EWDs.

To support his theory, Grush argues that Brooks' robots are able to realize some actions without emulators just because the electrical signal propagation in robots are much faster than in real biological systems. He claims that, without emulators, humans would not be able to perform that sort of functions. It seems that for more complicated actions, we really need representations. For Grush, the emulators are "the facilitators without which fast real-time accurate success (in the conditions at issue) would not be possible. They key, of course, is that representations as understood on the emulation theory are embodied in an emulator that is run *in parallel* with the body/environment" (Grush 2003, p. 85). This is beautifully constructed argument but we argued above that the "I" furnishes the expectations and predictions for the virtual motor actions in real time. The motor control does not need certain "inner models running in parallel with the body that can reduce the effects of feedback delay problems", as Grush claims. The "I" is the implicit knowledge and that would explain the understanding and the prediction of the sensorial-motor information and planning the future movements. In a different EW, parts of the brain deal with information received through sensorial and motor mechanisms from the external environment and they send new signals to other neural areas or to the body.

Grush brings another argument to defend the existence of representations: the *offline* cognitive processes. He thinks that, for the offline processes, the emulators use representations. We agree that the offline processes involve mental representations, but from the EDWs perspective, both online and online processes are the "I" or the mind-EW. The distinction between online and offline cognition has been analyzed and debated in various ways and under various names by scientists and

[9] Regarding this idea, see Lungarella and Sporns 2006; Vacariu 2008.

philosophers[10]. There have been proposed more or less similar concepts, such as "representation hungry" (Clark and Toribio, 1994), "online intelligence" (Wheeler 1994, Wheeler and Clark 1999) or "decoupleability-requiring" (Clark and Grush 1999 in Wheeler 2005, p. 213).

A particular case of offline processes is the mental imagery. Grush maintains that the emulator theory of representation could improve Kosslyn's approach to mental imagery. He thinks that emulators are the missing part of Kosslyn's approach arguing that the top-down processes of visual perception are the outcome of the emulators (Grush 2003, 2004). For Grush, "the emulation framework explains exactly how it is that the same process that can operate off-line as imagery, can operate on-line as the provider of expectations that fill in and interpret bare sensory information"[11] (Grush 2004, p. 392). From the EDWs perspective, the top-down processes are the effects of the high-level neural patterns on the low-level neural patterns. Thus, such effects *correspond* to the influences of the implicit knowledge on the explicit/perceptual/motor knowledge on one side and the influence of high-level to low level neural patterns. As we already, the "I" is the implicit and explicit knowledge. (See Vacariu 2008, Principle 6) The images/representations of the external environment are parts of the "I" and this is the reason the "I" can carry out the emulator's functions. But again, we do not need any emulator for accomplishing such functions. Evidently, the "I" acquires the implicit knowledge during the developmental period. Based on this knowledge, the "I" can realize the emulator's functions. We really cannot identify precisely the neural areas of any particular emulator. Surely, we will need to explain the correspondence between the entities and processes of the brain-EW and the mind-EW. Nevertheless, we have to be aware that the mental functions are not realized by the emulators, but by the "I" that corresponds to the whole brain and body. "Correspondence" does not mean "emulation" at all. From an EDWs perspective, we believe that any "cognitive" agent needs the unity of the mind-EW and not only the existence of representations. These representations are the "I"! Without such unity, the "I" or the "it" would be what Hume called "an ensemble of physical elements" (including the emulators) and in this case the "it" were not able to survive and evolved. In this sense and only in this sense, the "I" has evolved from the "it"! (See Vacariu and Vacariu 2008)

3. Wheeler and the "Cartesian psychology"

If Grush returns to certain assumptions of the Cartesian framework, we want to analyze, from the EDWs perspective, Wheeler's interpretation of Descartes' philosophy within the context of cognitive science.[12] Wheeler makes an interesting amalgam between theories of cognitive science and ideas from Heidegger's philosophy (Wheeler 2005). Wheeler analyzes two fundamental issues in the book:

I. The famous debate between two paradigms from cognitive science: (a) the "orthodox cognitive scientists" (incorporating both computationalism and connectionism) with which the majority of cognitive scientists agree. It presupposes a kind of Cartesian psychology (assuming the representations with eight principles, but rejecting the dualism) (b) an "embodied–

[10] "Derek Bickerton (a linguist) celebrates 'off-line thinking' and notes that no other species seems to isolate problems in their own performance and take pointed action to rectify them-see Bickerton (1995)." (Clark 2001, p. 154)

[11] "… the emulation information processing structures produce imagery (the *a priori* estimate) that is used to interpret, fill in, anticipate what the sensors will produce." (Grush 2003, p. 79)

[12] For an interpretation of Descartes philosophy, see Vacariu 2008, Chapter 1.

embedded cognitive science" (that is a "lenient" dynamical system approach and its relatives having a kind of weak representations involved).

II. The idea of "embodied–embedded cognitive science" and the replacement of the Cartesian framework with Heidegger's philosophy (Wheeler 2005).

Wheeler's attempt is to show that the Cartesian framework can be identified in most of cognitive science's literature (named by Wheeler, the "orthodox cognitive science")[13]. Wheeler introduces eight interrelated principles for characterizing the Cartesian framework. To put it shortly, these eight principles are could be subsumed by the following ideas: the duality mental-physical elements involves the duality of cognitive subject-world of objects, human cognition presupposes the subject-object dichotomy, the mind is explained through manipulating and transforming the representations, perception is inferential taking the form of sense-represent-plan-move cycles, the role of the environment and of temporal dimension are not important in understanding the functions of human mind (Wheeler 2005, Chapter 2 and 3). Wheeler's main idea is that "… the eight principles of Cartesian psychology define a conceptual position toward which orthodox cognitive science tends overwhelmingly to gravitate, and at which it regularly comes to rest" (p. 56).

Wheeler analyzes the three main approaches from cognitive science: the classical view (computationalism), connectionism, and what Wheeler names the "*embodied–embedded cognitive science*" (the dynamical system approach) (Wheeler 2005, p. 11). Computationalism and connectionism could be regarded as a sort of Cartesian approaches as both paradigms involve representations, decoupleability, and the role of the body and the environment are not necessary in explaining cognition. The embodied–embedded approach is based on the fundamental idea that cognitive science needs to put cognition back in the brain, the brain back in the body, and the body back in the world (Wheeler 2005, p. 11).

Wheeler's perspective is quite close to Brooks's embodied cognition and the dynamical system approach, but he wants to hang on to the notion of a weak representation (at least for the sake of decoupleability). Working within the unicorn-world, it is understandable why cognitive scientists are trying to avoid putting together in the same equation mind and brain, body and environment. We argued elsewhere (Vacariu 2008) that the brain, the body and the environment interact and in trying to explain the functions of the brain, it is impossible avoiding the other two entities. These three entities belong to the same macro-EW, or what we call the brain-body-EW. While, on the other hand, the mind is just a different Epistemological World and it is meaningless to say that the mind interacts with the external world[14]. Even if Wheeler offers strong arguments against a pure Cartesian framework, he still retains the Cartesian idea of mental representations, as they are necessary to explain the decoupling mental functions.

Let us analyze one of these Cartesian principle, the *principle of explanatory disembodiment* from the EDWs perspective. According to Wheeler, the principle of explanatory disembodiment means that human cognition can be explained without using information furnished to each intelligent agent by bodily sensations or certain perceptual states. In other words, a reliable and flexible intelligent action remains conceptually and theoretically independent of the scientific understanding of the

[13] Against the orthodox paradigm of cognitive science (the Cartesianism) and related to embodied–embedded cognitive science, Wheeler offers the paradigm of Heidegger's philosophy. Evidently, we do not analyze this framework here.

[14] For more details about this debatable issue see Vacariu (Vacariu 2008).

agent's physical embodiment (2005, for instance, p. 51, p. 81 and p. 84). Obviously, essential for this principle is the relationship between cognition and perception. Following Wheeler and in order to illustrate the Cartesian relationship between the subject and the world, we introduce Descartes' three grades of perception (Wheeler 2005, p. 41)

Grade 1 – Perception is given by the immediate effects of the external inputs on our body and brain

Grade 2 – Perception represents the immediate effects on our mind like the "experiences of light, colors, sounds, tastes, smells, heat, and cold'".

Grade 3 – Perception presupposes the 3-dimensional framework with properties like size, shape, and distance of objects being entirely the results of rational judgments.

The EDWs perspective is an extension of the Kantian transcendental philosophy and as we agree with Waxman's expression "the world is the self" (Waxman 1995), we claim that our representations of the external world are the self or the "I". For Kant, all kind of information received from the external environment is incorporated within the framework offered by the transcendental apperception that is the union between the intuitions and the categories. Therefore, from our viewpoint, all Cartesian grades of perceptions are the "I". Within the "I" (or the mind-EW), these grades of perceptions are indicated by the dichotomies declarative-procedural, conscious-unconscious, explicit-implicit, accessible-inaccessible, and controlled-automatic knowledge[15]. Within the "I", it is incorporated not only the world but also the body. There are different states of perception with different degrees of consciousness, but all of them are the "I". Also, within the brain-body-EW, all these kinds of knowledge *correspond* to the interactions between the body and the brain and their elements. If it is to accept this perspective, then we avoid the infamous Cartesian "pineal gland" (the transducer)[16] that had to assure the "bidirectional channel of causation that ran from body to mind in perception, and from mind to body in action". (Wheeler 2005, p. 21)
Wheeler claims that there are two kinds of dualism are the heart of Descartes' philosophy: the mind-body and the subject-world. These two dichotomies could be solved only within a slightly modified Kantian framework, in which we give up to the noumen-phenomen distinction and we replace the concept of "world" with the concept of EDWs. Within this framework, Heidegger's "thrownness"[17] of the subjectin the world is reversed: the external world is incorporated within the "I". The essential dichotomy between online-offline cognition is avoided because the perception is the "I".

A similar sort of analysis can be done in robotics on the so-called "transducers". Even if there have been made remarkable progresses in this area, the actual robots have nothing similar to human subjectivity. We consider that human subjectivity is actually knowledge and this knowledge (both perceptual and cognitive) is the "I". We do not need any sort of transducers to mediate between the body and the mind. Transducers are not the "gates" from one EW to another; they do not exist

[15] For a more detailed analysis of these dichotomies, see Mandler 1998; Vacariu 2008)

[16] "Transducers are A.I.'s answer to the pineal gland" (Haugeland 1993, p. 14 in Wheeler p. 85)

[17] "… the term 'thrownness' expresses the Heideggerian claim that in everyday cognition the intelligent agent always finds herself located in a meaningful world (a context) in which things matter to her…" (Wheeler 2005, p. 276)

in human mind. The big mistake in cognitive science is that researchers have been looking for these transducers which connect the mind with the external world. There is a strong connection between the body, the brain and the environment, but the cognition is the mind-EW (or the "I"). Within the unicorn-world, the eternal issue of the "transducers" cannot be solved. What the robots are using as transducers could be considered as parts of the "brain" which are strongly connected to their bodies and the external world.

Furthermore, from our viewpoint, Wheeler's analysis of issues like "causal spread", "from continuous reciprocal causation", the modularity of the mind, homuncularity, and aggregativity could not lead to any viable solutions just because he situates his analysis within the framework of the unicorn-world. For instance, we admit that there is a causal spread and continuous reciprocal causations, but only between the brain, the body and the environment. These interactions *correspond* to particular mental states that are part of what we call mind-EW or the "I", but the mind, being an EW, cannot interact with the environment, which is, let's say, a macro-EW, so an EDW.

Representations are necessary for homuncularity as well, argues Wheeler. The "homuncular explanation" in which one illuminated the behavior of a complex system by compartmentalizing that system into a hierarchy of specialized subsystems that (i) solve particular, well-defined subtasks by manipulating and/or transforming representations, and (ii) communicate with each other by passing representations. (Wheeler 2005, p. 254) In our opinion, homuncularity is mirrored by the unity of the implicit knowledge that is the "I" or the mind-EW. Thus, the "I" accomplishes the functions of homuncularity. It is obvious that we cannot talk about representation without "*those representations first being interpreted or understood*" (Wheeler 2005, p. 258). According to Wheeler, the neural areas of the brain are engaged "with internal representations, and, literally speaking, parts of the brain don't understand anything" (p. 258). Here we agree with him. Even if we take into account the whole brain, we cannot find any meaning or syntax correlated with a particular mental state. Only the mind-EW has mental representations (with their syntax and semantics), that is, the "I" is the sum of all mental representations and processes[18]. Homuncularity is not at higher level of analysis, as Wheeler suggests (p. 259), because, if "levels" are EDWs, then there is no causation between them. (See Vacariu and Vacariu 2008) The solution to this problem seems again to be changing the paradigm, that is, to replace the unicorn-world (which presupposes the existence of "levels of analysis/organization/ontological") with the EDWs paradigm.

4. Conclusion

Thinking within the unicorn-world paradigm, Wheeler is partially right: cognitive science is still dominated by the main ideas from the Cartesian framework (excepting, of course, the dualism). However, it seems that the path to follow for solving these issues is a Kantian approach improved by the EDWs perspective and not the mixture of "embodied–embedded cognitive science" paradigm and Heidegger's philosophy. The fundamental issue in cognitive science is not Descartes' ghost, but the unicorn-world paradigm which undermines the human thinking in general, and particularly of those who work in cognitive science. Most of the issues within cognitive science are pseudo-problems, false problems that are not correlated to the right framework/paradigm. There is no such dichotomy between the subject and the

[18] See principle 4 in Vacariu 2008.

external world, because, as Kant puts it, "the world is the self". We can talk about representations only within the mind-EW or within the unity of the "I". And it is not a unity that can be proved within the brain-body-EW, but has to be postulated because all the neural patterns and processes *correspond* to the "I" that has a unity. Otherwise, mental functions such as systematicity, would not be possible. The mind-body problem itself is a pseudo-problem within the EDWs framework and it should be reconsidered.

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