The Phenomenal World Inside the Noumenal Head of the Giant: Linking the Biological Evolution of Consciousness with the Virtual Reality Metaphor

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Abstract: In this paper I describe our subjective consciousness from a biological perspective. From this perspective, I suggest that we can describe the phenomenal consciousness as an analog of a "virtual reality" system created by means of biological evolution. This biological virtual system appears to have evolved "in order to" integrate our multimodal afferent stimulus and to generate a self centered subjective space (our subjective daily space) filled of emotional and volitional contents. I also discuss some paradoxes relative to a biological description of consciousness, like the classical "brain inside the vat" paradox, the "zombie" paradox and the "homunculus" paradox. The main conclusion is that we cannot locate the consciousness in our daily subjective space because we, as observers immersed inside the conscious process, cannot observe and locate the conscious processes from outside them. As a result, to us consciousness appears to be located everywhere we observe. However all indirect evidence suggests that consciousness is, primarily, a biological "virtual" process generated by our brain physiology. To deal with this fundamental aspect of our subjectivity (embodied in each observer) I propose a didactic approach to metaphorically "locate" consciousness in the space: "the Giant World Metaphor". In this didactic metaphor we exist, normally without notice, inside the invisibles "giant brains" belonging to "invisible giants" living in an invisible "giant world" (this giant world is analog to Kant's noumenal objective world). These objective "invisible giants" generate, inside their "giant brains" the biological virtual systems we daily experienced as our bodies and our external subjective reality. Although deeply "weird" to our daily common sense, this "giant world metaphor" help to put in evidence a fundamental aspect about the problem of consciousness location: even when we observe our heads and brains we are not observing the "real" and objective (in a strict sense) place where consciousness is generated, but rather the indirect experience of our head and brains mediated by their own subjective

and physiological processes.

Key Words: consciousness, phenomenal, virtual, topology, internalism, externalism, evolution, zumbi paradox.

Resumo: Nesse trabalho eu faço uma descrição de nossa consciência subjetiva dentro de uma perspectiva biológica. A partir dessa perspectiva, sugiro que podemos descrever nossa consciência fenomênica cotidiana como um análogo de um sistema de realidade virtual criado pela evolução biológica. Esse sistema virtual biológico teria evoluído aparentemente "a fim de" integrar os estímulos multimodais aferentes, provenientes de nosso corpo e do ambiente externo, e para gerar um espaço subjetivo centrado no observador (o nosso espaço subjetivo cotidiano), um espaço preenchido de emoções e volições. Também discuto alguns paradoxos clássicos relativos a uma descrição biológica da consciência, como o paradoxo do "cérebro dentro do vidro", o paradoxo do "zumbi" e o paradoxo do "homúnculo". A principal conclusão que desenvolvo é a de que não podemos localizar a consciência em nosso espaço subjetivo, porque nós, enquanto observadores imersos no processo consciente, não podemos observar e localizar os processos conscientes a partir do seu exterior. Portanto, para nós a consciência parece estar localizada em todos os lugares que observamos. Para lidar com esse aspecto fundamental de nossa subjetividade (encarnada em cada observador) eu proponho uma abordagem didática para metaforicamente "localizar" a consciência no espaço: "a Metáfora do Mundo Gigante". Nessa metáfora didática nós existimos, normalmente sem percebemos, dentro de "cérebros gigantes invisíveis" pertencentes a "gigantes objetivos invisíveis", gigantes que vivem em um "mundo objetivo gigante e invisível" (esse "mundo gigante" é análogo ao mundo numenal objetivo da metáfora de Kant). Esses "gigantes objetivos invisíveis" geram, dentro de seus "cérebros objetivos gigantes" os sistemas biológicos virtuais que experimentamos no cotidiano como nossos corpos e nossa experiência de espaço externo subjetivo. Embora profundamente "estranha", ao nosso bom senso cotidiano, a metáfora do "Mundo Gigante" nos ajuda a pôr em evidência um aspecto fundamental sobre o problema da localização da consciência: mesmo quando observamos nossas cabeças e cérebros, não estamos observando o lugar real e objetivo (em senso estrito) onde nossa consciência é gerada, mas sim a experiência indireta de nossas cabeças e cérebros, uma experiência mediada pelos seus próprios processos subjetivos e fisiológicos.

Introduction

There was a time when the ability of our muscles to generate movement and the inheritance of genetic characteristics appeared to be an eternal mystery surrounded by an aura of "magic". In the present, the ability of our brain to generate visual, auditory, tactile and all kinds of sensations and feelings is still partially covered by this same kind of "aura", although we have made immense progress in understanding how neural physiology is related to the generation of our conscious quotidian realities (Damasio, 1999, Metzinger 2000a, Dehaene & Naccache 2001).

Researchers have described the afferent nervous pathways that collect stimuli from the world outside the brain, whether from our external sense organs or from the sensory systems situated in our internal organs. In addition, now we are beginning to have a more precise description about how different patterns of brain activity, especially in the thalamocortical areas, are associated with the conversion of this afferent information into conscious sensations (Baars, 2002). We have also described the efferent pathways that allow our conscious wills to be converted into actions performed by our bodies.

Furthermore, we have even developed a basic understanding about how these afferent-efferent connections are blocked, normally during REM sleep, allowing the brain to self stimulate and generate the strange "offline" realities we experience during dreams (Gottesmann, 1999; Maquet, 2000).

So, although the precise biophysical mechanisms that generate our day-to-day sensations are still a "mystery" (like muscular contraction or genetic inheritance in the past), there is a consensus forming in the scientific

community that sensations and feelings are a by-product of brain physiology in the same way contraction is a by-product of muscle activity.

The Metaphor of "Neuro-Virtual Realities"

If sensations are ultimately generated inside our brains, a theoretical external viewer would describe our day-to-day recreated realities as analogues to a collection of "virtual reality" environments generated inside separate brains (Revonsuo, 1999; Lehar, 2003). These "neuro-virtual experiences", although generated inside different brains, are also partially synchronized, due to the afferent-efferent pathways, with the same common global reality.

This description can be called the "virtual reality metaphor of consciousness", and it captures some key aspects about the relationship between what we imagine the objective reality would be, and what we experience as our day-to-day reality.

Virtual reality devices are electronic artifacts that allow us to experience spaces and objects that are not really there, and they can also allow us to experience space and events remotely located. For example, a system of mobile cameras and microphones placed in a European street, and connected online with a virtual reality device somewhere in America, allows an American citizen to experience a walk around a European landscape without directly being there.

Thus, we can describe the brain, metaphorically, as a kind of "virtual reality generator", which allows the environment outside the brain to be experienced inside it. This "out-of-brain" world comprises not only the body's external environment, but also the internal environment of other organs outside the brain (actually, we are going to demonstrate that the brain's

"virtual system" generates not only a virtual world, but also a virtual self in the center of this virtual world). Each brain generates this virtual world and self using the afferent stimuli, external and internal to the body, and the virtual self produces virtual decisions and actions that will affect our body through efferent outputs (Merker, 2005).

However, if we compare our nervous system to a virtual reality system, it becomes obvious that our brain is much more powerful than any similar artificial device yet invented (which is why the virtual reality is only a didactic metaphor to describe consciousness). Actually, the brain has three fundamental differences when compared with artificial virtual reality generators:

1- The brain's virtual reality presents not only video and audio, as the artificial analogues normally do, it can also generate olfactory, gustatory and tactile virtual experiences;

2- In addition to these multi-modal experiences, the brain's "neuro-virtual" reality also contains emotions and feelings, like pain and pleasure, or love and hate.

3- Moreover, a important difference between the reality we experience and an artificial virtual reality is that our nervous system, like its artificial analogues, does not only generate the experience of the environment around the self. The brain also generates the experience of a virtual self in the center of this virtual environment (Metzinger, 2000). This “neuro-virtual” self is generated by the afferent impulses that come from the internal organs and from the brain itself, allowing us to experience sub-sets of the functioning of our own brain (in the course of this paper we will explain how the generation of a virtual self inside the brain does not lead to an infinite regression of "homunculus inside another homunculus").

Consequently, we can metaphorically compare our day-to-day reality, described from an abstract external point of view, not only as a kind of virtual reality, but rather as a kind of "sentient-intelligent virtual reality game", where even the first person character is a virtual entity, a virtual self interacting with a virtual environment.

Everyday Reality as a First-Person "Virtual Game"

At present, for example, there is a very popular version of this kind of game that features a virtual "hero" called "Laura". In this game, Laura can navigate and perform actions inside a virtual world. But Laura is not an external observer experiencing the virtual world inside the computer, she is also a virtual part of the simulation as is the virtual world that surrounds her.

Like Laura, what we experience as our self is a by-product of the same brain activity that generates the external sensations of objects we perceive. However, unlike Laura, the actions we perform in our virtual day-to-day "game" are synchronized, due to afferent-efferent connections, with the "out-of-brain" world. So, our day-to-day virtual actions can have strong real consequences for our bodies and lives (Laura, unlike us, can "die" and be "reborn" several times without any problem). We do not exist, like Laura, inside a solipsist isolated world, a "big illusion", but in a connected "online" "neuro-virtual" world where our actions indirectly affect, and have consequences for, the dynamics of the common reality and vice versa (Noe, 2002).

Indeed, we can assume that it is the effects on our ancestors' survival and reproduction that have selected the way our brain generates the experience of ourselves and the world around us. The specific kind of "neuro-virtual"

world and self we experience do not evolve only by chance mutation (that would be an incredible coincidence), but because it has been selected against several alternatives (mutants that experience, for example, predators as close friends; or the fact or being injured and bleeding as a joyful experience; have probably left many less descendants than our ancestors) (Carruthers, 2000).

Although the ability to generate some kind of "neuro-virtual world" probably has been a crucial aspect in the evolution of our lineage, this does not rule out the possibility that other lineages of organisms have solved the same problem (how to navigate a complex body through a complex, potentially dangerous, environment) using another evolutionary solution (we are going to return to this question when we discuss the premises utilized by the "robot/zombie" argument).

Arguments Against the Virtual Reality Metaphor of Consciousness

If we use the metaphor of a virtual reality with a virtual self at its center, we obtain a very accurate description that explains a vast amount of experimental data, about the relationship between our day-to-day reality and the rest of the physical universe. However, we still have some logical arguments that appear to be against the virtual reality metaphor of consciousness. We can group these arguments around three basic problems:

1- THE "BRAIN IN THE VAT" ARGUMENT: as brains do not exist in isolation from their surrounding environment ("inside vats"), it makes no sense to postulate that what we experience as our day-to-day reality was generated by and inside our brains (Dennet, 1991);

2- THE "ROBOT/ZOMBIE" ARGUMENT: As we can imagine, and perhaps even build, organisms and machines that can behave in a way similar to

humans, but without having an internal (and conscious) "virtual reality", evolution had no reason to have selected the development of "neuro-virtual" processes inside our brains (Chalmers, 1996);

3- THE "HOMUNCULUS" INFINITE REGRESS ARGUMENT: if we describe conscious reality as a "neuro-virtual" reality generated inside our heads, we need to assume that inside our heads there is a small "neuro-virtual" human, a "homunculus". Using the same logic, this homunculus will harbor inside his small virtual head an even smaller virtual reality with an even smaller homunculus ... and so on (Dennet, 1991). This would lead us to an absurd infinite regression that would prevent us from using virtual reality as a useful metaphor for consciousness.

I am going to show that the previous three arguments, despite their relevance to other questions (and actually they are very productive arguments in the history of the philosophy and science of consciousness), cannot be used to dismiss the virtual reality metaphor of consciousness as a result of biological evolution.

Regarding the first argument, consider that muscles, like brains, normally do not exist "inside vats". They need nutrients, oxygen and energy to work. Moreover, the way our muscles work is also influenced by our cultural makeup and individual decisions (they can be more tense or relaxed, for example). However, with the experimental evidence we have now, it is very difficult to maintain that our muscles do not generate our day-to-day body movements. Analogically, although our brains do not exist "inside vats" (but in a constant flux of matter, energy and cultural information), it is becoming more and more difficult to maintain that what we experience as our every day reality, or as our dream reality during dream states, is not generated by our brains.

It is certain that "correlation is not necessarily causation", but, as we now have so many cross correlations between brain physiology and reality experience, we are reaching a point at which we need to invoke a "divine" statistical coincidence to deny that our brains are not the organs where matter, energy and information blend together to generate what we experience as our day-to-day world (we also have so many “statistical coincidences" between brain lesions and corresponding losses in aspects of phenomenal reality, as well as between direct brain stimulation and the experience of vision, hearing, touch etc.).

Thus, in the present, maintaining that our brains do not generate our whole day-to-day experiences is becoming as difficult as maintaining that it is only a statistical coincidence that, whenever our arm muscles contract or stretch, our arm moves. (However, postulating that brains generate our day-to-day reality is not exactly the same as postulating that everything we experience is inside our heads. This happens because, according to the "neuro-virtual" reality approach, what we experience day-to-day as our heads are also sensorial experiences generated by our brains. This problem will be addressed later in this paper).

The robot/zombie argument can only be used as an obstacle to the virtual reality metaphor, if we begin with the premise that evolution can "solve" a survival problem using one, and only one, kind of solution. However, natural history has plenty of examples showing that different lineages of organisms can develop different useful solutions to the same problem. Consider, for example, what happens if we try to use the robot/zombie argument to question whether hemoglobin (the protein that transports oxygen in our blood) is important for respiration. We will generate the following three, absurd, arguments:

1- We can postulate that, since cockroaches, like other insects, can respire without having hemoglobin in their blood, hemoglobin is only an "epiphenomenon" with no evolutionary value to human fitness;
2- Since we can build robots that behave like us without using hemoglobin, or even oxygen, the concept of hemoglobin is not important to understand our biological evolution;
3- Since we can imagine "zombies" being identical to ourselves, except the fact they lack hemoglobin, and that these imaginary zombies can do everything we do, we can conclude that hemoglobin is useless to our respiration and, consequently, to our survival and reproduction.

From the above absurd conclusions, it becomes clear that we cannot use the robot/zombie argument to dismiss the evolutionary value of a trait, even if this trait is the ability of generating hemoglobin molecules in our bone marrow, or the ability of generating conscious "neuro-virtual" realities inside our brains.

One correct way to address this question (if a given trait has an evolutionary value) is to try to study what really happens to the fitness of an organism when we selectively knock out the trait we are studying (and we cannot only use imaginary experiments in this situation).

For example, if the hemoglobin function were selectively knocked out in human beings, due to inhalation of small amounts of carbon monoxide, it would produce dramatic negative effects in real human fitness (but not in imaginary "non-hemoglobin zombies"). So, the ability to produce hemoglobin is a major factor in our evolution, just as in other red-blooded vertebrates. This happens even if we consider that the same hemoglobin has no importance to respiration in insects, which have evolved a different respiratory mechanism

(or even if we can build robots that do not use hemoglobin to do the same things we do).

Although we know much more about the physiology of respiration than that of consciousness, we are accumulating more and more experimental evidence that the brain's capability of generating conscious "virtual environments" is, like hemoglobin, a fundamental trait that affects our fitness (but perhaps not for cockroach fitness or robot functioning) (Dehaene & Naccache 2001).

When studies are performed with individuals in situations where consciousness is partially knocked out, due to localized lesions in the cortex or masking procedures that prevent consciousness from being aroused, what is documented is the loss of several complex cognitive abilities. So, it is extremely unlikely that a human, whose consciousness has been “knocked out”, could survive and reproduce, living in his ancestors' complex environment, relying only on his unconscious cognitive abilites.

Consequently, although other lineages of organisms may have solved the same cognitive problems our ancestors solved without using consciousness, this does not necessarily dismiss the importance of this trait to our evolution.

The infinite absurd regression only appears, in the homunculus argument, if we describe conscious reality as a small perfect copy of total reality (like a mirror reflecting itself). As a perfect copy of reality must also contain a copy of itself, this process would lead us to an infinite absurd regression. However, the same experimental data that sustain the metaphor of our day-to-day reality as a "neuro-virtual" environment also strongly suggest the brain does not generate a perfect virtual copy of all of reality. As a result,

our day-to-day, "neuro-virtual" worlds are not kinds of "mirror worlds" containing infinite, absurd, small copies inside them.

In fact, what the experiments with conscious perception suggest is that the day-to-day realities our brains generate are complex “edited" versions of all of reality, which do not necessarily contain infinite copies inside them. Actually, if our "neuro-virtual" worlds were only small, non-edited, copies of the total reality, probably there would be less evolutionary advantage in generating them. However, if the brains selectively suppress and add features to our "neuro-virtual" realities, editing them in a way that has enhanced the fitness of our ancestors, now it makes evolutionary sense that we experience a "neuro-virtual" world generated inside our brains.

Coincidentally, if we compare what we experience daily as reality and what our indirect measurements tell us about what the "objective" reality looks like, we will find many examples of suppressive and additive processes performed by the brain (Grossberg, 1999). In the "neuro-virtual" metaphor, this editing process was selected due to two main forces:

1- To achieve a cost-benefit compromise between improving the quality of information gathered from the "out-of-brain" reality, without wasting excessive amounts of energy and time;

2- To generate a virtual experience of the world and the self, containing emotions and feelings that will stimulate future behavior with improved probability of fitness increment.

To solve the cost-benefit problem, our brain generates a reality where aspects with low importance to the fitness of our ancestors tend to be suppressed, while important aspects (some of them not directly present in the primary sensory data, but inferred from it) are added to our virtual conscious world.

Consider, for instance, some classical examples of suppressive and additive mechanisms that work to build our conscious visual world. Our brain suppresses the conscious perception of our saccadic eye movements or the view of the blood vessels inside our eye balls, for example. On the other hand, the brain adds the sensation of 3D stereoscopic space and object motion to our conscious visual world (the retinas only produce two sets of 2D stimuli from which the brains infer and edit the sensation of visual space and movement) (Watson et al., 1993; Anderson, 1998; Zeki & Ffytche, 1998).

Another fundamental additive effect performed by the brain is the addition of emotions to our “neuro-virtual” world. When we see, for example, a facial expression in our day-to-day world, we do not just see muscles contracting and stretching, we also see a complete set of emotions that are added to the face, even a face that is only painted on canvas. (Bruce & Young, 1986; Haxby et al. 2000)

So, when we are examining a painting made of ink droplets representing, for example, a perspective scene containing a facial expression, there are so many aspects of the scene that are added and suppressed that it makes no sense to describe our perception as a "mirror of reality" (nor as a “big illusion”, because we are also gathering some real information from the painting). What we are experiencing is a new "neuro-virtual" reality transformed from the afferent impulses that reach the brain.

If our ancestors had become greatly distracted, for instance, by the sensation of the blood vessels inside their eyes rather than paying attention to the sensation of a potential predator approaching, we probably would not be here. On the other hand, when the ability to add emotions to perceptible faces evolved (allowing, for example, our ancestors to add angry emotions to enemy faces, and happy emotions to smiling friendly ones), this surely

increased their ability to survive and reproduce (and also pre-adapted them to the future appreciation of paintings representing facial expressions).

The same complex pattern of additive and suppressive processes can also be used to describe how what we feel as our every day body and mind are generated. On the one hand, the brain suppresses many details from the body's total reality, we have, for instance, less sensation derived from our internal organs than from our skin, especially on our hands, face and tongue.

On the other, many perceptual features are added to our primary somaesthetic stimulus information to build what we experience as our every day body. When we spend a long time without eating, for example, we do not feel only the muscles of our stomach contracting, we also feel the sensation of hunger located in our bellies. Although the hunger stimulus is partially generated in the brain, by the hypothalamus, the feeling is added to our stomach experience.

Thus, according to the "neuro-virtual" metaphor, our conscious world is neither an exact "mirror" of the total reality (a useless mirror reflecting itself into an absurd infinite regression) nor a “big illusion”. It is a specially "edited version" of the out-of-brain reality, which generates the feeling of what we call our selves and the experience of a world around us, in our every day life.

How Communication and Social Cognition are Described Using the “Neuro-Virtual Reality” Metaphor

Another apparent paradox of the virtual reality metaphor is how to reconcile the "in-brain" generation of individual realities, inside separate brains, with the constant exchange of information among individuals we experience daily. If our every day realities are generated inside separate

brains, how is intersubjective communication possible? And why do we feel the sensation of sharing the same common space with other human beings, if what we experience are several different, "neuro-virtual" spaces recreated inside different brains?

To address this fundamental question, let us imagine several computers online, connected through wires, running several versions of the same "virtual game". Inside each computer's virtual space, we will have a different principal character, a virtual "self". In each computer, the respective self will occupy the center of the space surrounded by secondary characters. The self in the center of the virtual space in one computer will be generated as a secondary other self in the other computers and vice versa.

The online wire connection will synchronize the games in the computers in a way that it will appear we have only one common virtual space, and only one game running, rather than several interacting games running in parallel. The fundamental analogy between these computer games and consciousness is that, although all the computers share the same physical universe, the electronic virtual selves inside them do not directly interact in exactly the same common physical space. The virtual spaces and selves inside the computers indirectly exchange information and interact through the wires without being at the same location.

Now, if we have human beings interacting, rather than computers, the "neuro-virtual" metaphor postulates that the several brains will generate several virtual spaces, each one containing a "neuro-virtual" self surrounded by virtual other selves. As I will experience myself, for instance, as a self in the center of my own virtual space, the others will experience me as another self on the periphery of their spaces and vice versa.

However, although being generated inside separate physical brains, the "neuro-virtual" spaces and selves will interact and communicate with each other. Pressure and light waves will stimulate the sense organs inducing nervous impulses, which, instead of electric current through the wires, will allow the several “neuro-virtual” spaces inside the brains to share similar experiences and cultural values, without being in exactly the same physical space.

Thus, according to the "neuro-virtual" model, we neither experience completely separate physical universes nor the same common space directly. Our every day realities and selves are generated inside different physical brains that share the same common physical universe (a huge universe we infer to be mostly outside our direct experience).

Dreams, for example, are superb demonstrations of the "neuro-virtual" nature of our every day reality (Revonsuo, 2000). In dreams, we can still feel our self and body in the center of a space, surrounded by other selves and objects. However, during dreams we have almost no afferent-efferent connection between our brains and the rest of the physical universe. This "offline" state allows our brains to generate the non-shared, and sometimes bizarre, experiences of selves and spaces we can have while dreaming (Gottesmann, 1999).

As we assume that several persons dreaming are generating several dream spaces inside their heads, spaces that are singular and bizarre due to a lack of afferent-efferent synchronization, we can also assume that several awake persons are still generating spaces and selves inside their brains. To the "neuro-virtual" metaphor, the body we experience while awake is generated in the same physical space as our body experienced while dreaming: inside brains.

The difference between being awake or in a dream, according to this perspective, is not the difference of being inside or outside the brain, it is the difference between being inside the brain "online" and "offline" with the rest of the physical universe.

How to Visually Represent Several Consciousnesses Interacting in the Same Physical Space: the “View from Nowhere” Puzzle

Science often relies heavily on visual diagrams to summarize theoretical concepts. Whenever we have new theories and measurements we try to describe them as visual diagrams made by a hypothetical objective viewer. Although this kind of diagram can make the concepts more concise and easy to understand, they can be problematic. This happens because normally these didactic pictures attempt to translate processes outside our direct perception, the result of several indirect measurements and experiments, into something we can "see".

Consider, for instance, the atomic diagrams, the classical pictures of electrons spinning around a nucleus, which condense the result of several experiments into one concise and didactic "view". However, these pictures can also lead us to the erroneous assumption that we can directly see individual atoms.

The same happens with “pictures” about consciousness. If several experiments strongly indicate that consciousness is generated inside the brain, we will naturally try to represent how a theoretical external viewer would "see" several brains generating their own consciousness. However, like individual atoms, it is also impossible to really see consciousness from outside (an external viewer trying to look at consciousness from the outside would be,

by definition, unconscious and, therefore, incapable of "seeing" anything) (Nagel, 1986).

So, due to the physical impossibility of really "seeing" consciousness from outside, we have to choose between two coherent procedures. Either we abstain entirely from translating the "neuro-virtual" model of consciousness into visual pictures, or we choose to use visual diagrams only as didactic tools (like the visual diagrams of atoms).

If we opt for the second choice, I would propose an imaginary description called the "giant world" diagram to represent several consciousnesses, in-brain generated, in a visually translated form. Imagine a diagram where we have a giant world inhabited by six billion theoretical "giants". These imaginary giants are the descendants of a biological lineage of giants, who evolved the ability to generate consciousness, as "neuro-virtual" realities, inside their “giant brains”. These "neuro-virtual" realities have been tuned by natural selection across countless generations, to edit the afferent impulses that arrive in the giants' brains, suppressing some useless aspects (like saccadic eye movements) while adding others (like emotions, feelings and 3D visual space).

As a result, we can "see", in our didactic diagram, a world of "giants" that generates small virtual realities inside their "giant heads". Each "giant's brain" will also generate the experience of a virtual self inside it, built using the giant afferent propriosensorial impulses - a virtual self in the center of a 3D virtual space full of objects, feelings and emotions.

When the virtual self, inside the giant's head, makes decisions and performs virtual actions, it produces efferent impulses that will be translated into actions carried out by the giant, actions that can affect the giant's probability of surviving and reproducing.

Objects or acts associated, directly or indirectly, to survival and having descendants (like food, friendship and sex) are selected to be recreated with pleasant stimulating feelings added, while acts and objects that have decreased the fitness of our ancestors are, in general, recreated with unpleasant or less stimulating feelings associated to them.

To complete our didactic "picture", we can imagine several of our "giants" meeting together to talk and interact. A "neuro-virtual" self, inside the head of one of the giants, would have the strong feeling of directly speaking and interacting with the other "neuro-virtual" selves. However, we can "see", using our imaginary "eye", that all the "neuro-virtual" selves are talking and interacting using a kind of indirect "online" connection. This "biological connection" is made by the afferent-efferent impulses that link the giants' brains with the giants' bodies. Beyond the bodies, the connection is maintained by the physical-chemical signals (light, sound, smell etc.) that travel through the space separating the giants' bodies.

This imaginary scene would seem like the "neuro-virtual" selves inside the giants' heads are experiencing a kind of virtual biological "teleconference", allowing them to interact and communicate remotely among themselves without leaving the interior of each giant's brain.

This imaginary "picture" of individual conscious worlds inside different "giant heads" is no more real than a "picture" of an individual atom. However, like the atomic diagram, the "giant world" consciousness diagram capture and condense, in a didactic form, many experimental aspects about how several individuals' consciousnesses interact with each other and the whole physical (“giant”) universe.

Concluding Remarks

All experimental results about cognition and physiology strongly support the notion that what we experience, as our every day realities, are, in fact, recreated biological realities generated inside our brains using afferent information. These recreated realities, partially analogous to virtual realities generated in computers, comprise not only a recreated environment but also a recreated self in the center of this "neuro-virtual" space.

These "neuro-virtual" spaces and selves are supposed to have been naturally selected during the evolution of our lineage as an adaptive solution (but not necessarily the unique evolutionary alternative) to modify the afferent information our brain receives, suppressing some features while adding others, and by generating an intelligent-sentient system, the self, to navigate through this modified environment.

This recreated world allows the virtual self to act and learn in ways that have enhanced the survival and reproductive fitness of our ancestors. We do not experience, for instance, the two-dimensional and emotionless physical world our eyes are supposed to perceive initially. Rather, we experience a three-dimensional recreated world filled with feelings and emotions, feelings and emotions that probably have strongly affected our ancestors' behavior and fitness.

As the experiments make it more and more clear that our every day experience is a reality recreated by brain physiology, we are tempted to visualize, given that we are visual organisms, this new concept. However, it is physically impossible to truly visualize consciousness from outside (just as it is physically impossible for astronomers to truly see the universe expanding from outside it).

As a result, it is not entirely true to say, for example, that our consciousness is located inside what we commonly consider to be our heads. This happens because the vision of our heads is also a "neuro-virtual" recreation made by our brains using our heads' original afferent stimuli. The best we can do to satiate our natural desire to visualize things is to produce imaginary didactic pictures, which translate the experimental data into a visual format (like the astronomers do when picturing the universe expanding or the physics when visually representing the atoms that are supposed to compose everyday matter).

Consciousness is located, by definition, everywhere we experience its conscious events, inside and outside what we experience as our conscious body, in a dream or in an awake state (Velmans, 2000). Even when we are studying brain physiology, we are studying not the brains directly, but what we are experiencing as a brain.

However, we can picture, as a didactic tool, consciousness as being generated inside the heads of theoretical "giants". These imaginary "giants" were selected during their evolution to modify the afferent data their senses receive, and to create new small realities inside their "giant" brains. In the virtual center of these recreated "small worlds" a sentient-intelligent virtual self experiences itself and the "neuro-virtual" world around it. When this recreated self performs actions and takes decisions it generates efferent stimuli that will affect the "giant's" behavior. If the virtual self induces efferent behavior that allows the giant to survive and reproduce, the genetic rules of recreating a virtual world inside his head will be inherited by the giant's descendants.

We are, in this imaginary "picture", the "neuro-virtual" selves in the virtual center of the heads of these didactic "giant's" descendants.

I suggest that it is a matter of choice to use or not such a kind of didactic picture. We can also regard the generation of consciousness by our brains as a biophysical process that, although it can be experimentally studied in a very predictive way, it cannot be properly represented in a common sense visual form (like some quantum physical processes that cannot be properly represented using our common sense language).

But we cannot avoid, without facing increasing difficulty, the concept that we neither experience directly the out-of-brain reality nor a kind of exact mirror reality created inside the brain (which endlessly reflects itself generating an infinite absurd regression). All the experimental evidence points to the fact that what we experience is a new neurobiological reality, a space and self recreated and modified by our brains.

Science works by producing objective, so-called "third person", pictures about reality. Although these third person pictures are only theoretical abstractions used to make best predictions (nobody can truly see the world from outside his "first person" point of view), objective abstract pictures can be powerful tools to enhance our subjective quality of life (for example, the theoretical concept of invisible "virus", which explains several disease symptoms, has enhanced the quality of life of millions of people around the world).

The “neuro-virtual” description of consciousness is very useful because it allows us to understand better why different individuals can have different experiences about the same universe, without using several different superimposed metaphysical universes. We are surrounded by, and “online connected” to, the same common “giant” physical universe, mostly outside our direct perception.

However, we can only directly interact with small individual fractions of this huge universe. These fractions work as recreated "neuro-virtual sub-universes" generated by our brain's physiology and modified by our individual and cultural peculiarities.

Actually, if we could choose between interacting directly with the objective “giant” external universe, mostly deprived of life, emotion and meaning, or, indirectly, as part of our smaller recreated every day realities, full of feelings and biologically generated experiences, probably we would choose the second option. One fundamental meaning in making objective science is the subjective, “neuro-virtual”, pleasure of discovery.

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