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Review Article

On Scientific Explanation of Consciousness

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Abstract

The possibility of explaining consciousness in terms of already known scientific laws depends upon whether living beings' behaviors are subject to the same physical laws that have been successful in explaining processes of lifeless matter. A close look at what is common to and what is different between today's intelligent computers and the brain at a functional level, seems to reveal some fundamental differences in the behaviors of living beings and lifeless systems. We discuss here the following aspects of conscious behaviors: phenomenal information, awareness, retro causality, observation of one's own ongoing activity, feeling of self and subjectivity, and free will. The computer-brain comparison also reveals other aspects of living beings' behaviors such as remembering and reasoning, which are often considered as requiring consciousness but which actually do not! The benefit of such knowledge is to eliminate unnecessary effort to look for consciousness in wrong places.

Keywords : Consciousness, phenomenal information, awareness, retro causality, free will.

Introduction

Modern scientific research of consciousness has evolved into an interdisciplinary effort involving both physical and social disciplines, such as neuroscience, quantum physics, cognitive science, computer science and even eastern and western philosophies. There has been an explosion of research and results in neuroscience over the last three decades with emphasis on understanding and explaining consciousness. Some neuroscientists believe that the "hard problem"[4] is not hard any longer and some computer scientists believe that they are very close to building a conscious computer. In spite of the many seminal and outstanding accomplishments in this field, it seems that there remain some fundamental questions which need to be addressed when one tries to provide a scientific explanation of consciousness. In this article, by comparing some intelligent functions performed by today's computers with corresponding behaviors of human and other living beings we point out some aspects which suggest fundamental differences from a scientific point of view, in the behaviors of living beings and lifeless systems. As far as we know, these aspects have not been explained scientifically yet. We also point out some other aspects of living beings' behaviors which we often consider as requiring consciousness but which actually do not! The benefit of such knowledge is to eliminate unnecessary effort to look for consciousness in wrong places.

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Defining Consciousness

To explain something scientifically one first needs to define it. The main difficulty with consciousness is its definition because the word consciousness is used to refer to many different phenomena[4]. To define any aspect of consciousness, one needs to introspect oneself to understand clearly what it is. Unfortunately understanding one's own mind from one's behavior is difficult and the answers obtained by self introspection may be misleading sometimes. For example, we think that birds, animals, and other living beings have various degrees of intelligence and of course, that a human being is more intelligent than all the other species; it is reasonable to think so because for example, people do arithmetic whereas animals usually cannot. Interestingly, our packet calculators can do arithmetic always accurately and much faster than we can. But we do not think that calculators are intelligent. At the same time, if a person does arithmetic like a calculator (and we hear about such people once in a while), he/she would be called a genius! Do we know what we mean by intelligence or consciousness? Similarly, from the fact that a living bird can fly freely in the sky whereas a dead bird cannot, one should not infer that the ability to fly distinguishes living and lifeless beings and that the act of flying requires consciousness; after all, an airplane can fly too. In this age of robots, we cannot be sure that a bird's ability to fly on its own whenever it wants to (without any assistance from a human pilot like the plane for example) is evidence that birds have some intelligence but airplanes do not; there are auto-pilot aircraft which do not need human pilots either. The so called drones have computers in them and fly in enemy territories without human pilots. Nowadays, machines can see, hear, talk, walk, and even solve mathematical problems! They play music as well! So, today's machines perform many activities of intelligent and conscious human (living) beings but of course, the machines are not conscious. If so, what is consciousness?

The point to note in all these examples is that there is a certain component of a human being's intelligent or talented behavior which does not involve consciousness and another which does. The latter is experience, desire to do things, initiating appropriate action, and awareness of doing them besides simply doing them. Today's machines can realize the former component that is, perform actions but not the latter. This observation is not entirely new because for example, Chalmers[4] emphasizes the distinction between performance of a function and the accompanying experience. However, Chalmers does not talk much about how the brain initiates the performance by itself; we will discuss later in section 4 why this ability to initiate action distinguishes living beings from lifeless matter and needs further attention in a scientific study of consciousness.

We will distinguish between consciousness and awareness as Tulving[18] does. He defines conscious-ness as a particular ability of living systems and awareness as an internally experienced outcome of exercising this ability in a particular situation; he defines remembering an event as being aware now, of something that happened on an earlier occasion. We will use the word consciousness in a broader sense to cover various abilities of the mind including the ability to create awareness of an experience; other abilities of consciousness include the ability to pay attention, executive control of action, free will, and sense of self. We will define awareness in more detail in section 3.

Monism, Dualism, Dual-Aspect Monism

Today, we find primarily, three schools of thought among scientists who attempt to explain consciousness in scientific terminology. One school, which may be called scientific materialism, believes that mental states are identical with brain states and that our thoughts and feelings, and our sense of self are all properties of electrochemical activity in the brain. In other words, although in our daily life, we find consciousness in human beings (and in other living beings in varying levels) but none in lifeless objects, this school of thought assumes that there are no fundamental differences from a scientific point of view, in the functioning of living beings and lifeless systems and that it should be possible to explain consciousness in living beings by means of already known fundamental physical laws. Today's computers, which think like human beings if not better, and do superhuman tasks, reinforce this belief. In general, neurobiologists (for example, Edelman[5], Crick and Koch[6], Watson[19]) belong to this school. On the other hand, others like Sir John Eccles[7] argue that there is a mental world in addition to the material world and that our mind or self is involved in the functioning of the brain at a basic level. (Together with quantum physicist Beck, Eccles proposes that consciousness is involved at the quantum level, in increasing the probability of exocytosis)[1], the basic activity that initiates information flow between neurons in chemical synapses. Eccles's mode of thinking, known as dualist interactionism, assumes that minds of living beings are fundamentally different from lifeless systems. The main criticism of this second school is that its propositions are not experimentally verifiable because notions such as the mind, feelings, thoughts, and sense of self are not mathematically or scientifically defined within the theory. The third school of thought tries to solve this problem and provide such definition by proposing that mind is a dual-aspect of living matter, for example, like the wave associated with a quantum particle. David Bohm[2,3] was a dual-aspect theorist who considered consciousness as the dual aspect of an infinite sequence of quantum potentials at successive levels, each controlling the one below. Bohm's collaborators, Hiley and Pylkk¨anen[12] claim that their theory avoids dualism without falling into reductive materialism because a particle and its wavefunction on whose shape the quantum potential depends, are two different aspects of just one reality. However, they do not explain why mind is not present in any lifeless quantum system as the dual aspect of the system's quantum potential. Moreover, the quantum potential guides the motion of the particle but the particle has no impact on the quantum potential; therefore from the Bohm-Hiley hypothesis (that the mind is nothing but a collection of quantum potentials at various levels), one can infer that mind acts on the brain but cannot explain that the brain acts on the mind also.

Consciousness is Not Required for Remembering and Reasoning!

Our personal computer (PC) can tell for example, that an earlier memo from the boss is inconsistent with the one typed into it now! It remembers, all previously entered memos; rather, because it has no awareness, it PRETENDS TO REMEMBER them and understand them. It can read, write, recall, compare the input with its stored contents, and even evaluate the input but it is aware of absolutely nothing!

The PC is able to recall and make judgments because it is equipped with a memory containing some data and some instructions to handle input or stored data. A simple typewriter cannot do what the PC can; the typewriter cannot retrieve the earlier typed memo and therefore cannot compare it with the one typed now because it has no memory with data and the necessary programs. Note that neither the typewriter that types the memo on the paper, nor the paper which contains the memo, nor the PC into which the same memo is entered, understand the contents of the memo but the PC can judge the contents of the memo like we do! The point is: the act of recalling does not require consciousness! Nor does arguing logically require consciousness because again, a machine can do it if it has a memory with appropriate software. We are able to prepare the PC to pretend such intelligence because information residing in our brains (at least some of it) can be mapped into languages, and then words can be mapped into the states of some hardware units, and therefore mappings of information from the brain can be stored in the PC's memory. The PC is then able to carry out all the operations of receiving input data, storing, retrieving, and processing them, and finally giving some answers to questions, solutions to problems, results, or judgments but none of these activities clearly requires consciousness because the machine does them all!

"Real" Information is Different from any of its Representations

One common characteristic of a computer and a living brain is that information is stored in both. We know how it is stored in a computer. The digital computer has a bunch of memory cells, each of which can exist in either of two states denoted by '0' and '1'. Writing information is the process of driving these cells into '0' or '1' states. Reading information is sensing these cells to know in which states they are. What information is represented by bytes of '0's and '1's is decided by the programmer and not by the computer.

In the case of a quantum computer, the representation is in terms of qubits, which are micro-objects whose states are all linear combinations of '0' and '1'; still, meaning is assigned to the qubit states '0' and '1' by the computer programmer. So, the machine carries only a representation of some information but does not really know or understand the information. To communicate some information which is in our minds, we use words; since different words are used in different languages, words are not the same as the meaning they convey. The sound we produce when we utter a word is not the same as the meaning. The electrical signals that are transmitted through a telephone line are not the same as the meaning, wireless signals transmitted and received by cell phones are not the same as meaning, and so on. All means of communication that we use to convey information in our minds involve matter and material energy. They all really carry only a representation of what is in the brain but not the actual meaning or thought. So also, all means of storing our thoughts outside of the brain, involve a material medium such as books, CDs, databases, all of which are different from the meaning they store. So, in the brain, there is "real" information called phenomenal information by Chalmers[4], but not merely a representation; this information is different from the language or the energy signals used for its communication just like water is different from its container although water cannot be carried from place to place without the container. Note that sensory experiences such as seeing an object, hearing a sound also create representations in brain's memory, in the form of bonded nerve cells and therefore a brain's memory is also a store of representations. However, in addition, there is an experience of seeing, hearing, knowing etc. in the brain. Moreover, the brain seems to contain some information, which is not a neural representation of any material object in the outside world. For example, time is not a representation of any material object; the concept of time is created in the brain by itself and the brain uses time as a key to order the neural records stored in its memory. Hence the following question is yet to be answered: How is this "real" information created in the brain or who assigns meaning to neural assemblies or pathways?

Awareness and self Awareness

One difference between a computer and a human being is that a human being knows what he/she is doing at least when awake whereas a computer does not. What does it mean to know oneself or even to know something? Nowadays, we are very much used to expressions like "the computer knows", "it understands", "it thinks", etc. What we unintentionally mean when we say a computer "knows" an object is that a representation of that object exists in the computer's memory. Hence we may define:

Definition: A computer behaves as if it knows an object or aware of an object (a data item or a program instruction), when a representation of that object as bytes of "0"s and "1"s in a digital computer or qubit states in a quantum computer, in other words, as a sequence of states of some hardware elements (let us call them hardware correlates), exists in its memory.

Note that the above definition of awareness applies to a human brain with the following difference:

Definition: A brain is aware of an object (which may be an experience) when a physical representation (neural correlate) of that object together with its "meaning" exists in its memory.

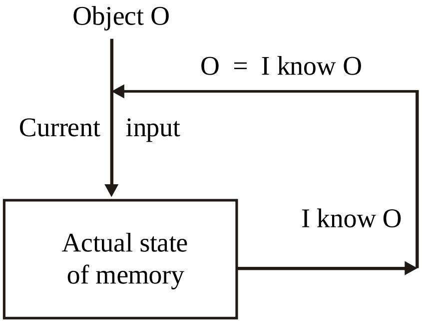
The nature and structure of "meaning", the mental record is not yet known. Dualists think that it is nonphysical and exists independently from its neural correlate; dual-aspect theorists think that it is subtle but it is one of the two aspects of the neural record, and monists think that it is a property of the neural record. But the above definition holds in all theories. In a dualist theory, this definition suggests the possibility of presence of unconscious thought in the brian. In a dualist theory, the definition also allows for the occurrence of Libet's delay-and-antedating paradox[14] and the readiness-potential paradox[15] because a neural record and the associated mental record can be created at different times.

Once such a representation is contained in its memory, the computer can perform any number of operations with it (when the operations are also supplied to it as software). The computer can compare the object with another object also known to it, add, subtract, compute functions of it, draw a picture of it, and so on. The computer can do almost anything that a person can do with it and behave as though it "knows" the object. In fact, computers do so many miraculous things that we often wonder whether they are more intelligent than we human beings! But does a computer "really know" the object? Of course, not. A paper on which a few sentences are written, does not know the meaning of these sentences. The person that wrote them knows their meaning. A person who utters a word knows its meaning. The sound does not. The computer is similar. It does not know the meaning of its memory contents. On the other hand, the brain does. Let us try to see what if any, aspect of storing representations happens differently in the computer versus the brain.

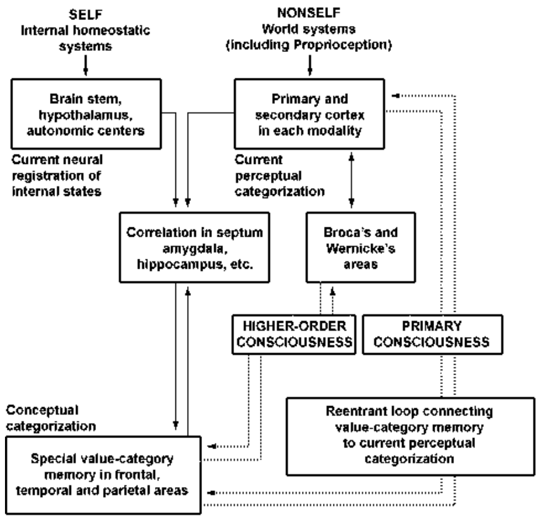
Self-Awareness Loop

According to our definition of awareness, we can see that a computer cannot know what it is doing (call it self-awareness for brevity noting that this self-awareness has nothing to do with metaphysics or self-awareness described anywhere outside of this article) as follows. Let us try to simulate self-awareness and see what happens. Suppose that a digital computer knows an object O; hence a representation of O as a sequence of '0's and '1's is already written into its memory. To be self-aware, the computer must know that it knows O, so it must also contain in its memory the sentence "I know O (or O is in the memory)" and for the same reason, it must also have the sentence "I know that I know O" and "I know that I know that I know O", and so on. So, the computer must be equipped with a mechanism which would write all the sentences in this infinite sequence, once a representation of O is written into its memory. Then the machine enters into an infinite loop and write, write, and write until it runs out of all its memory space. Also, writing each sentence in the loop takes some time however small it may be. Thus the computer with a finite (but not infinite) storage space and a finite (but not infinitesimal) writing time cannot complete the infinite loop. What about a quantum computer? A quantum computer does have the potential to be millions of times faster than today's most powerful supercomputers and many times larger storage capacity. Can it complete the infinite loop? The answer is no because a quantum computer cannot compute something which a digital computer (a Turing machine) cannot[13]. Why bother about an infinite loop, why not consider a finite loop instead? The computer can certainly complete writing a finite number of sentences in the self-awareness loop but clearly, it does not know what it is doing even then because the computer usually produces logs of its past activities but it does not know their meaning. On the other hand, it is our common experience that unlike in a computer, there is constant observation going on in a human brain at least when awake. When I observe an object I remember the object and also the act of observation. For example, while reading a book I am aware that I am reading, and what I am reading every instant. This leads us to wonder whether in a brain, there is a computer-like but continuous reading and writing taking place in such a way that the read and write operations take infinitesimal times for completion.

Interestingly, although Edelman does not mention any infinite loop explicitly, the REENTRY, A RECURSIVE PROCESS CRUCIAL FOR CONSCIOUSNESS, in his theory of dynamic core hypothesis, may actually be doing this loop. Edelman defines reentry as "the dynamic ongoing process of recursive signaling across massively parallel reciprocal fibers…" One function accomplished by the reentry process is called recursive synthesis, which allows higher-order perceptual constructs to be used as inputs for lower-order maps through repeated reentrant signaling[9].



Infinite loop of writing in a computer



Re-entrant loop connecting value-category memory to current perceptual categorization in a recursive way. Taken from Edelman (2000, p 108).

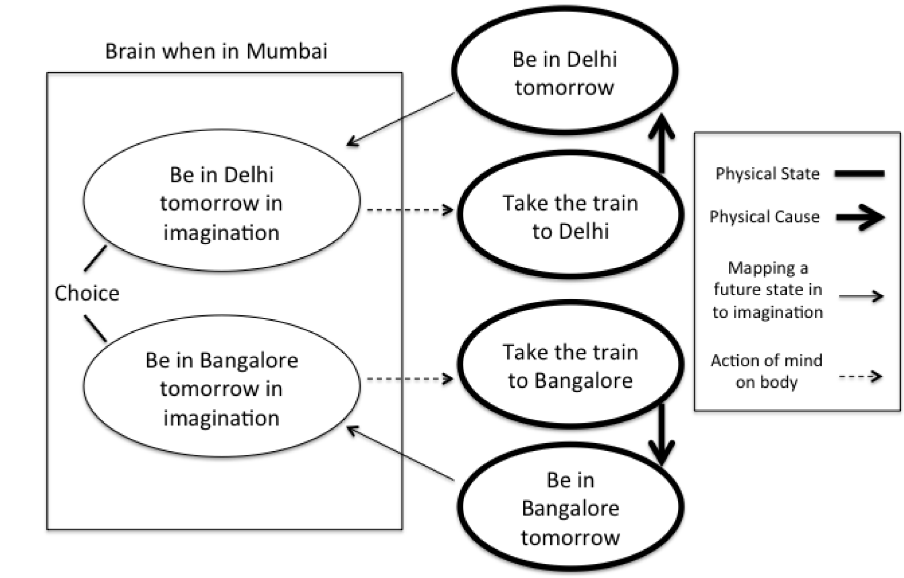
Inductive Reasoning and Causality

In our daily lives, human beings' actions are often initiated by desires, purposes, needs, and goals, which are all associated with our future states (activities of other living beings have purposes too). Living beings choose to do whatever they do, in order to achieve a goal. A person takes a plane, bus, train, or some other transportation in order to go to a place other than where he or she is at present. A cat jumps on a mouse in order to kill it. Note that jumping happens now and killing the mouse later but the cat has figured out that it should jump on the mouse first and it does just that. Intelligent behaviors involve inductive reasoning and therefore they are associated with a type of causality different from that of lifeless material systems. Macroscopic lifeless systems obey laws of classical physics that a cause should always precede its effect. Even microscopic lifeless systems which are subject to laws of quantum physics obey the so called weak causality principle[5], which states that a controllable message cannot be sent backwards in time in any reference frame. The relativistic causality principle limits causes to the past light cone of the effect, based on the principle that causal influences cannot travel faster than the speed of light.

Circular Causality

Let A and B be two statements such that B is true whenever A is true. Then we say that A implies B or B follows from A and write A→B. Deriving a new statement B whose validity solely depends upon the validity of one or more statements, say set A, by a chain of implications, is called deduction. If B is true whenever all the statements in A are true, then we again write A→B. On the other hand, given a statement B, to figure out a set of statements, which will imply B, is one form of induction. There may be slight variations of statement of the causality principle but they all agree that if a set of events A causes an event B then any event in A cannot occur later than B. A lifeless computer (digital or quantum), implements only deductive reasoning even when it simulates inductive reasoning and obeys the principle that a cause must precede its effect. On the other hand, living beings often do inductive reasoning because their actions are often initiated by motives. The search for an appropriate course of action and the action itself depend upon some information about a future state; for example, if I want to go to Delhi from Vizag I will take a train to Delhi but not to Bangalore. Therefore, the change from my present state depends upon information regarding a future state. In the case of inductive reasoning, when one tries to figure out a set A of events that will lead to B, not only A is a cause for B but A also depends upon B. In the Delhi example, whether to take a train or not depends upon whether I want to go to Delhi or not. Similarly whether to take a train to Delhi or to Bangalore depends upon whether I want to go to Delhi or to Bangalore. Thus deductive and inductive reasoning involve different types of causality and both types are present in our thinking[1]. This state of affairs seemingly violates the causality principle of physics that a cause should always precede its effect. Hence, if actions of living beings take place because of information about some future states as said above, then an interesting and yet-to-be-answered question is "Are such actions consistent with the principle of causality of either classical or relativistic physics, and if not how does one justify them?"

One may argue that there is no causality violation in inductive reasoning because the brain already contains the future state information which is required to initiate the appropriate action. However, the goal in my PRESENT IMAGINATION is not the same as the future physical state of my body because I am not in Delhi yet. The imagined goal is a mapping of the future physical state (different from the present physical state, else no action happens), into my present memory. So, THE PRESENT MEMORY CONTENT DOES DEPEND ON A NOT YET REALIZED PHYSICAL STATE. Hence alternatively, one may ask the question: How does the brain create in its present memory, a mapping of a future physical state of itself? Is there causality violation while creating the goal in the present imagination? Note that there is no causality violation in a computer (which plays chess for example) because the programmer enters what the goal should be into the computer, whereas in a brain, the goal is created by the brain itself. We are so much used to thinking inductively and being motivated to act by our desires and goals that we hardly ever recognize that our brains may be following circular causality where not only a future state is the effect of the present state but action in the present is also the effect of a future state.



Action at present with a purpose in mind depends on the chosen future state information

A computer can exhibit subjectivity

Subjectivity is often explained as follows: perception is not independent of the individual perceiving but conditioned by personal attitudes, personal views, previous experience, or background. In a slightly different way, Searle[16] explains subjectivity as follows: "Conscious states only exist when they are experienced by some human or animal subject. In that sense, they are essentially subjective..... qualitativeness implies subjectivity, because in order

1. The deduction A→B is said to be deterministic if B is a single statement. Instead, if B is a set of statements B1, B2, …, and each of them is implied by A but with probabilities p1, p2, …, respectively and p1+p2+.. =1 then the implication A→B is probabilistic and not deterministic. If A and B are sets of events, and A→B is probabilistic, it means that one of the events B1, B2, .. must occur if A already occurred but the probability of B1 occurring is p1, that of B2 occurring is p2, and so on. A and B obey the causality principle if all events A happen not later than any of the events in B.

for there to be a qualitative feel to some event, there must be some subject that experiences the event. No subjectivity, no experience." Searle calls subjectivity a first-person ontology "as opposed to the third-person ontology of mountains and molecules, which can exist even if no living creatures exist. Subjective conscious states …… are experienced by some "I" that has the experience, and it is in that sense that they have a first-person ontology." Searle[17] also points out that a subjective experience is not EQUALLY ACCESSIBLE to any observer. Since an experience owes its existence to its subject, Searle's definition that subjectivity is to have a subject, does not contradict the usual explanation of subjectivity as the perception's inevitable dependence upon the background of the perceiving subject.

Let us consider applying Searle's definition of subjectivity to a robot for a moment. An experience by a subject (a living being or a robot) is nothing but a record created in the subject's memory. Most probably, the robot's record does not have any qualitative feel (phenomenal information inaccessible to others) to the robot but as seen earlier, the robot's outward behavior is not in anyway disadvantaged by lack of this mysterious phenomenal information! When a robot records an influence from outside, the record is its experience and the robot is its subject. As to the "I" aspect of the experience and the first person ontology, if the purpose of "I" is to distinguish oneself from everything else in the universe; the robot certainly does that. That is why we are able to develop and use computer communications. If the programmer gives the name 'I' to the robot, thereafter it will say "I know this", "I did this" and so on. A robot's inferences and conclusions always depend upon the knowledge it already has in its memory, which includes the heuristics entered by the robot's programmer as well as all the external inputs (vision, sound, motor, etc.) received so far. For example, two robots may look at the same person in front of them and one robot may say that the person is short where as the other robot may say that the person is tall; this happens if the definitions of "short" and "tall" entered into the robots' memories are different. So, a robot can have its own point of view and human perception is subjective in the usual sense (dependent upon the subject's background) for a similar reason. What two human beings learn, perceive, remember, or experience from the same situation in the external world tend to be different because their pasts are generally different.

Hence, to have a subject or to have first person ontology (to distinguish oneself from everything else) is not the difference in the qualities of an experience of a living being and that of a robot. But the difference is that in the case of a living being's experience, the subject is aware of the experience whereas the robot is not aware of its experience, it is not aware of anything. Anyone who searches its memory for the record obtains the same record and therefore another robot can have exactly the same experience. On the other hand, in the case of living beings there is no way of verifying whether two individuals looking at the same object have the same "real" experience (but not merely a material representation) because the "real" experience is inaccessible to others. Moreover, a living being's "I" is accompanied by an urge for survival and continuation. The computer has no such urge.

Free will and causality

The computer although not conscious, can still have a goal in its memory but that somebody else (whether living or lifeless), needs to enter the goal into it and initiate the program to achieve the goal. Clearly, the brain does create goals by itself, does initiate actions to achieve those goals, and has the ability to stop the action before it starts if the brain/mind changes itself (what Libet calls the veto power). Moreover, the brain is aware of its goals and constantly aware of the goal achieving action while it is being carried out. These abilities make us feel that we have free will.To make a decision, a computer program depends upon some rules stored in the computer memory and strictly follows them to arrive at the decision; the program never violates any stored instruction. What about the brain? Does it always need and use only stored information to make a decision? *Roger Sperry (1979)* explained free will as follows: "A given volitional choice may depend additionally on things like the memory and the mental perspective acquired by the subject (and any consultants) over a span of many decades preceding the decision. ....complete freedom from causation would mean behavior purely on chance, on caprice and would result in meaningless chaos. What one wants of free will is not to be totally freed from causation, but rather, to have the kind of control that allows one to determine one's own actions according to one's own wishes, one's own judgment, perspective, cognitive aims, emotional desires and other mental inclinations." Thus usually, a human being's decisions and choices do depend upon desires, ambitions, goals, etc. all of which already exist in his/her memory. That is why many neuroscientists and computer scientists think that free will NOT SUBJECT TO CAUSALITY OR CHANCE is a delusion. Assuming that the brain uses only stored information to make a decision and that it never violates any stored rule in the process, such a decision is subject to causality irrespective of the fact that human beings are aware of their decisions unlike computers which also obey the law of causality. Why does it matter whether a free will not subject to causality or chance exists or not? Because if the answer is yes then science cannot explain such free will, science being a set of descriptions of cause-effect relations and their verifications.

Let us look at some examples of decision making circumstances to see whether free will not subject to causality or chance is possible. Now and then we hear stories like this: In the state of Louisiana there is a very long Causeway bridge that is rather high and crosses Lake Pontchartrain, a massive lake, awesome and extremely large. A woman bent down to open her glove compartment to get something out of it. Her car went through some cement railings and went down in Lake Pontchartrain. At the same time, a motorist who was about to get on the bridge noticed a piece missing from its railings. He got out to look around and saw the woman drowning in the water. The man dived into the lake and saved her life. In this episode, the motorist was not expecting to see a stranger drowning in the river. He had no duties of job requiring him to risk his own life to save the stranger; he could have just passed by. The motorist had nothing going on in his brain/mind related to the incident before it happened.moreover, to protect one's own life takes priority over helping others in anybody's mind even if he/she was taught at home or in a place of worship, to help others and have compassion for others; no religion would teach one to risk one's own life to help others. Hence the motorist's decision to jump into the lake did not follow from the rules existing in his memory. The rule "I should protect my life" which had been in his head since birth was changed by him on the spot. The only purpose of his action was to save the life of the drowning woman and the purpose was chosen by free will from two possible alternatives: one is the constant purpose to protect his own life and the other purpose is to protect the life of the stranger; the latter is created instantaneously by free will itself. This choice does not seem to be the result of any internal or external cause.

The above is an example of risking one's own life out of compassion. On the other hand, suicide bombers do more than risk their lives; they give up their lives not out of compassion but out of revenge towards a community or for a political purpose. This act is not initiated by free will (without a cause) because a lot of preplanning went into the act with the already established purpose of killing members of the other community. Harming the other community was already given a higher priority in their brains/minds over their own survival.

A second example is as follows: A robber with a gun chased a man threatening to kill him. The man who was being chased began to run as fast as he could for his life. As he was running around a corner, he passed by a clergyman just walking down the street but he continued running without taking notice of passers by. Soon, the robber with the gun following the fleeing man also encountered the clergyman.

Instead of passing by, he stopped and asked the clergyman which way the man being pursued went. The clergyman indeed saw which way the fleeing man went but told the pursuer that he did not see because telling the truth would endanger the life of the running man . Probably there are ways of talking to the robber to dissuade him from his pursuit but none occurred to the cledgyman's mind at that moment and he lied to save the life of the stranger. Thus he violated the rule "speak truth, only truth, nothing but the truth" which had been in his mind all along because he had been practicing teachings of the holy bible all his life. This ability to violate a rule of the past but not because of already established goals, and act on one's own is a self-starter or spontaneous and is the true free will. This ability refuses to be told what to do and refuses to be told by somebody or something else; it is above and beyond all causality. Now, one may say that clergyman might have been taught that he can violate his principle if doing so saves the life of another person. This would be an instruction in his memory which caused him to act the way he did. If so, clearly, his decision to lie was not free of causes and therefore not free will.

Even if free will (free of causality or chance) initiates an event, we have no way to distinguish the event from one that occurs by chance. The latter event may have a cause. We simply may not know what the cause is at the moment of its occurance; we do not know why an event with a small probability has occurred when the probability of its not happening is larger; we do not know what changed the probability. So, it is possible after some investigation (which may take several years!) that the cause may be found. In the case of free will not subject to both causality and chance, there is no cause to find!so the cause will never will be found.

One may be tempted to say that compassion is the cause of action that took place to save the life of a stranger in both the stories just narrated.But it is to be noted that compassion itself consists in violating all rules already existing in the brain.

Summary

We have discussed the following aspects of behaviors of living begingswhich seem to differ in a fundamental way from the behavior of a lifeless mechanical system from a scientific piont of view:

1. Information in a living brain is different from any of its representations used for its storage or communication.
2. **There cannot be self_awareness in lifeless matter,not even in intelligent computers of today** whereas human beings know what they are doing at least while awake.
3. Inductive reasoning takes place in human brains but not in computers and the causality associated with inductive reasoning is circular causality and different from the causality described in the well known causality priciple.

We also recognized:

1. The activities of receving input data, storing, retreving, processing them, reasoning, and finally giving some answers to questions, solutions to problems, results, or judgments do not require consciousness because the machine does them all! This observation leads to the open question: How does the brain perform the activities of initiating a problem solving or goal achieving process and produce awareness in addition to and accompanying the activities mentioned above?
2. Information in a computer is subjective in the sence that the computer is the subject of any record stored in it and that creation of a new record may depend upon alreay stored information. A computer also has the ability to distinguish itself from everything else in the universe and that is why computer communications are possible. So, simply claiming responsibility of actions by saying "I know this" or "I did this" is not the real sense of self. Computers are subjects with such abilities. The difference in living subjects and computers

is that the former are aware of their experiance (which is stored information) where as the latter are not.

3. Almost always.a human being's decisions and chioces depend upon desires, ambitions, goals, etc., all of which already exist in his/her memory. Living being's actions are initiated by motives. If the brain uses only stored information to make a decision and never violates any stored rule in the process, such a decision is subject to causality irrespective of the fact that human beings are aware of their decisions unlike computers. However, somehow we feel that ahuman being has the capability to suddenly violate all rules that he/she has been obeying until the beginning of an action and may indeed exercise that ability sometimes; in other words, free will not subject to causality or chance is not impossible. If such free will exists then science cannot explain it because science consists in describing cause-efect relations and their experimental verifications.

References

1. Beck, Friedrich and Eccles, John C. (1992). Quantum aspects of brain activity and the role of consciousness, Proc. Natl. Acad. Sci. USA, Vol. 89, pp.11357-11361.
2. Bohm D. A new theory of the relationship of mind and matter, Philosophical psychology, 1990; 3 (2): 271-286.
3. Bohm D and Hiley BJ. Undivided Universe. Routledge London & New York; 1993
4. Chalmers David J. Facing Up to the Problem of Consciousness. Journal of Consciousness Studies 1996; 3(1): 4-6.
5. Cramer J G. Generalized absorber theory and the Einstein-Podolsky-Rosen paradox. Physical Review D 1980; 22: 362-376.
6. Crick F Koch C. Neural Basis of Consciousness. International Encyclopedia of the Social & Behavioral Sciences. Elsevier Science Ltd. 2001; 2600-2604. http://www.klab.caltech.edu/~koch/Elsevier-NCC.html
7. Eccles John C. *How the Self Controls Its Brain. Springer-verlag. 1994.*
8. Edelman G Tononi G. A Universe Of Consciousness: How Matter Becomes Imagination. New York: Basic Books 2000.
9. Edelman G. The Remembered Present: A Biological Theory of Consciousness. Basic Books Inc. 1989.
10. Hari, S. (2002). http://primordality.com/consciousness.htm#living
11. Hari, S. A Few Questions about Consciousness Suggested By Comparing the Brain and the Computer. To be published in NeuroQuantology (2012).
12. Hiley BJ and Pylkk¨anen P. Can Mind Affect Matter Via Active Information? Mind & Matter 2005; 3(2): 7–27.
13. Hirvensalo M. Quantum computing. Springer-Verlag Berlin Heidelberg New York, 2004.
14. Libet B, Wright EW, Feinstein B, and Pearl DK. Subjective referral of the timing for a conscious sensory experience. Brain 1979; 102: 193-224.
15. Libet B. Do We Have Free Will? Journal of Consciousness Studies 1999; 6 (8–9): 47–57.
16. Searle, John. R. (1980) Minds, brains, and programs. *Behavioral and Brain Sciences* 3 (3*):* 417-457
17. Scarle, Johan, R. (1992) The Rediscovery of the Mind, Cambridge, MA, MIT Press.
18. Tulving, E. (1985) Ebignhour's memory : what did he learn and remember. Journal of Experimental Psychology Learning Memory and Cognition, 11: 485-490.
19. Watson D E, Williams B O. Eccles' Model of the Self Controlling Its Brain:The Irrelevance of Dualist-Interactionism. Neuro Quantology January, 2003; 1:119-128.

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