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回声论证：科学有可能解释意识吗？

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摘要: 由大量物理学基本粒子构成的脑, 究竟如何产生看起来完全非物质的现象意识或感受性? 本文提出一个新的论证, 表明用科学解释感受性存在根本性的逻辑困难。当前的物理学理论, 尽管高度抽象、涉及复杂的数学, 但其构建仍然基于一小组基本概念, 如质量、空间、时间等。对这些概念的理解依赖于对相关感受性的意识体验, 比如对大小、位置和运动的知觉。作为物理学理论的核心, 这些感受性构成了表述其它非核心感受性的基本词汇: 比如, 颜色被解释为波长的变化, 声音被解释为原子的振动。核心感受性的选择不是唯一的。比如, 想象一个具有智慧的蝙蝠群体, 其听觉感知能力远远优于视觉。它们完全有可能建造一个蝙蝠物理学, 以回声的声音感受性如响度、频率等作为其理论的核心基元。由于不同的感受性本质不同, 不可通约, 所以使用基于一些核心感受性构建的科学去解释另外一些感受性存在循环论证。直接给予的、自明的感受性构成了我们的世界, 也构成了任何科学的基础。**关键词:** 心理学; 意识; 感受性; 回声; 科学描述; 理解; 视觉

The Echo Argument: Can Science Explain Consciousness?

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Abstract: How can the brain, a collection of physical fundamental particles, give rise to phenomenal consciousness, or qualia that seem totally non-physical? A new argument is proposed identifying a logical difficulty in any scientific explanation of qualia. The present physics theories, though highly abstract and mathematically sophisticated, are built on a small set of fundamental concepts, e.g., mass, space, and time. Comprehension of these concepts requires previous conscious experience with some visual qualia, e.g., perception of size, location, and motion. Such qualia are core to these theories as they constitute the vocabulary to describe and explain all other non-core qualia, e.g., color explained as wavelength variation and sound as molecule vibration. There is more than one possibility in the selection of the core qualia. For example, an imagined intelligent bat population, with good audition but poor vision, may well build a bat-physics using some of the sound qualia of their echo (e.g., pitch, loudness) as the core units. As different types of qualia are qualitatively distinct and incommensurable, it is circular to use a scientific construct composed of some qualia to explain other qualia. Self-evident and directly-given, qualia constitute our world and the foundation of any sciences.

Key words: Psychology; Consciousness; Qualia; Echo; Scientific description; Understanding; Vision

Introduction

Consciousness is familiar to everyone. Walking on river bank after the rain, breathing moist air, gazing at fresh and green reed, lifting glittering spray, all of these feelings are consciousness, namely “all the things happened on us and can be directly sensed by us” said in Descartes’ *Principles of Philosophy*. In Descartes’ opinion, all things may be illusion, only “I” as the thinker is indubitable. This “I” is spirit and mind, takes up no space, has no extensibility and resides in the machine of body, but it can exist separate from body. Human has a long history of pondering mind, spirit or consciousness, but it was Descartes who made systematical analysis and rigorous argument on the mind-body relationship. The mind-body dualism originated by him is therefore regarded as beginning of academic deliberation on the problem of consciousness. The mind-body dualism has an insurmountable core problem, which is how to explain the interaction between mind and body as different entities, e.g., how does the thought of wanting to drink water drive the hand with a cup? Therefore, the dualism is not accepted by mainstream academic circle though it ignited hot debates of hundreds of years in western philosophical circle. With significant progress of science since Descartes’ day, people have been commonly aware that it is brain that is the organ most closely associated with consciousness and the essence of the problem of relationship between body and mind is that between brain and consciousness. Influential major theories of consciousness in present academic circle can be summarized as following.

Scholars of a school inherited viewpoints of Descartes’ dualism and they hold that there are indeed two different things of matter and consciousness on the world. Physiologist Eccles, a representative personage of this school, holds that the “connecting neural cluster” of the left hemisphere is the interface of consciousness and brain. The information perceived enters consciousness through this neural cluster, while the unphysical consciousness controls the neural activity of brain, and then influences human behaviors^[1] through this neural cluster. However, the existence of this interface is short of experimental evidences.

Some scholars hold that both matter and consciousness are derived from a kind of neutral thing that can be classified from different perspectives into either matter or consciousness and there is no conflict or essential difference between the two. Such neutral thing is called “feeling” by Mach, called “pure experience” by James and called “event” by Russell. This viewpoint of neutral monism is embodied in theories of several contemporary philosophers. For example, Chalmers holds that information is possibly the basic existence, while matter and consciousness are detailed forms of information.

Denying the existence of matter, the idealism represented by Berkeley suggests that matters such as mountains, rivers, rooms and trees are existed due to they are sensed by human and they are essentially consciousness. The idealism suggests that things that cannot be sensed are not existed. This viewpoint is hardly to be accepted from common sense, but in opinions of some of contemporary scholars such as philosopher Hut and psychologist Shepard idealism is still partially reasonable^[3].

The epiphenomenalism originated by British philosopher T. Hobbes suggests that consciousness is only by-products of body activities and cannot affect any physical process. The epiphenomenalism is supported by psychologist Skinner, a representative personage of the behaviorism. Several popular viewpoints of contemporary theories of consciousness are essentially epiphenomenalism. For example, the eliminativism represented by Dannett suggests that the concept of consciousness is hotchpotch that refers no certain thing. Consciousness is just

like the shadow of a flying bird which has no role to play in the flying of a bird^[4]. In opinions of philosopher Searle, water is wet but each water molecule is not wet on the micro level, so “wetness” is an emergent attribute on the macro-level. Just like “wetness” is not mysterious, consciousness is a natural product of a complicate system of human brain that consists of several billions of nerve cells^[5]. In essence, the epiphenomenalism denies that consciousness has any effect and suggests that the problem of consciousness is an insignificant pseudo-problem.

Reductionism is a theory of consciousness upheld by many scientists. Reducing to the fundamentals or describing and explaining non-fundamental things with more fundamental things is a main methodology of physics. It is the most profound and successful reduction of physics that all natural objects that we see, including our body, are reduced to microscopic particles such as atoms and electrons. “Table and rock are nothing more than a mess of atoms” is a typical presentation of reductionism. Brain and neural scientists regard physics as a model of science and always expect to reduce brain and brain activities to the level of microscopic particle. Reductionists do not deny the existence and significance of consciousness, but they hold that consciousness is a function of brain and all consciousness phenomena can be reduced to interaction of neural systems. When the brain activity is made clear, the problem of consciousness will be solved accordingly. As an extreme form of reductionism, functionalism analogizes the relationship between brain and consciousness into that between computer software and hardware and regards all things happened in brain as information processing and regards consciousness as a product of information processing. Functionalism denies consciousness’ dependence on the brain and suggests that consciousness can be produced with neurons or silicon chips alike as long as the same information processing can be realized.

The last important one is the theory of limitation, the core point of which is that: the problem that how consciousness is created by brain activities can never be answered due to the cognitive competence of human is limited. Nagel points out that a man can imagine he is a bat and determines directions and guides flying by giving ultrasonic waves, but the imagined experience of bat is not equal to the experience of bat itself. Even if each cell of bat is made clear, human still cannot understand the experience of being a bat since human is not bat. The most particular point of consciousness is that it is a kind of individual sense beyond the scope of explanation of physics and neurosciences^[6]. Philosopher McGinn also holds similar viewpoints. He points out that pupils cannot understand the theory of relativity and a worm crawling on a plane can never understand the feeling of three-dimensional space. Human competences are evolved for seeking survival instead of understanding consciousness such that there are possibly things that could not be understood by human^[7].

The most significant conflict among present studies of consciousness is that between reductionism and the theory of limitation. The former is more supported by scientists and the latter is accepted more by philosophers. This conflict is clearly demonstrated in Chalmers’ discrimination of functional consciousness and phenomenal consciousness^[8]. He suggests that the former is related to functions of neural system and can be explained by physics and neurosciences as the “easy problem”, while the defining characteristic of the latter one is that it is non-functional subjective experience, also called “qualia”, that cannot be reduced to neural mechanisms, so the forming the “hard problem” of consciousness. The discrimination of the “easy problem” and “hard problem” indicates that the core conflict on consciousness lies in phenomenal consciousness rather than all other aspects of consciousness. If reductionism is true, consciousness would be nothing

more than a function of the brain and a product of the complex activities of a physical system. That means the world is essentially physical and there is nothing else but matters. If the theory of limitation is true, consciousness cannot be reduced to neural and physical activity. That means there is a kind of non-physical substance that will never be understood by human.

Some thought experiments were designed by philosophers with concept analysis for attempting to argue that there is an insurmountable gap between science and the answer for explaining qualia, and that consciousness can never be explained by science ^[9]. Though cleverly designed, none of these arguments is without defect. For example, the knowledge argument points out even if all knowledge about color is known to a man, it can neither substitute his consciousness of the actual color nor make him experience what color such as red feels like ^[10,11]. However, according to neurosciences, if a man is brought up in a black and white room, sensory deprivation will be existed in the process of growth and the photoreceptors for color perception will not be developed. Showing the stimulation of red to men like that and asking what feeling they have or asking them to judge such stimulation is just like showing an infrared stimulation that we cannot feel and asking what feeling we have. Such questioning intrinsically makes no sense. The “zombie” argument assumes there are “zombies” with the same physical structure as real human but they have no feeling and consciousness ^[12]. However, if the brain of “zombies” also consists of neurons and their body structure is the same as that of human, they will like everyone around us and there is no a priori reason for us to believe they have no consciousness. Stripping sensation from brain, the zombie argument has already presupposed that sensation can be separated from substance, so its argument is restatement of its presupposed viewpoint and will not constitute a valid argument. Arguing that human cannot understand consciousness using the analogy that a two-dimensional worm cannot understand three-dimensional space is also defective. Fundamentally different from a worm, human can use tools and languages. Tools and languages make human possibly explore, survey and express all things and matters and make human intelligence and cognitive ability exceed the restriction of sense organs. Human can never feel ultrasonic wave, but it does not mean human cannot understand such sound wave. If a worm has the same intelligence of human, it is unreasonable to say it cannot gradually obtain knowledge about three-dimensional space and realize things in three-dimensional space unless there is no interaction between such three-dimensional space and the two-dimensional space of the worm.

In summary, reductionism suggests that the consciousness is a function of brain activities, denies mystery of qualia and limitation of science and believes that science can surely give reasonable explanation to consciousness. Giving prominence to the particular subjective qualia of consciousness phenomena, the theory of limitation is based on daily experience of human and suggests that the qualia cannot be reduced to molecules and atoms. From reductionism, people can see optimism and confidence of scientists: science can explain everything on the world, so it can surely explain consciousness. However, generalization cannot bring necessary truth. Even if all swans seen in the past are white, the next one may be black. Consciousness may possibly be a black swan. The theory of limitation more conveys pessimism and doubt of philosophers: how can the pure physical science describe the nonphysical qualia? How can a mess of neural cells produce the bright colors and the fragrant scents? However, doubt can only raise criticism and questions to viewpoints of others, but it cannot directly bring new understanding.

In this way, through pondering and repeatedly arguing between philosophers and scientists over recent 400 years, the millennium problem of the relationship between consciousness and

matter is formulated increasingly clearer and explicit, but its answer is still confusing. Reductionism and the theory of limitation, as two leading parties of the argument, formulate respective viewpoints more than providing convincing arguments. Common people are lost between the constantly accompanying and irrefutable direct experience and the mighty and systematic science.

The long-standing of the problem of consciousness requires us to find a new way of thinking. "Can science explain consciousness?" By taking a new look at this problem, one can see that people considered much about "science" and "consciousness", but they neglected analysis of "explanation". If one recognizes that both the physical world presented by science and the spiritual world presented by consciousness are non-deniable, it seems we should consider more about what is "explanation" and what it means when we say "explaining matter with science".

When we meet a new thing such as zebra, the doubt that "What is this?" will be aroused. By observing, contacting and understanding natures and characteristics of the new thing, we will get familiar with it and the doubt will be cleared up. When we see oddness of behaviors of things, e.g. a rabbit is disappeared when it jumps to a patch of grass, the doubt that "How could this be?" will be aroused. Getting closer to observe and finding a deep hole under the grass, then the doubt will be cleared up. When the correlation between things is found, e.g. it will rain after clouding, and such things and the correlation therein are familiar, the doubt "Why there is such correlation?" will be aroused. By pondering and imaging there are water drops or there is a god of rain in dark clouds, the doubt will also disappear. In this way, an individual clears up doubt and understand external matters through external behaviors and internal cognition, though this kind of understanding is not necessarily correct. This kind of process that understanding is realized by an individual itself forms a process of self-explanation, which possibly happens on both animals and human being and not necessarily needs language.

Explanation will be involved when an individual who realized understanding wants to let other individuals understand. It can lead other individuals to contact the new thing (such as the zebra) or reveal scenes (such as the hole under the grass) to clear up the confusion of others. These courses of explanation also not necessarily need language. However, the thinking activity of an individual has to be explained by language. Also to explain to a group of individuals, it is more difficult to resort to direct experience, so language is more likely to be needed. In this way, with understanding as precondition, explanation is more complicated than understanding and needs language generally.

Daily explanation are expressed with daily expressions. Scientific explanation must use scientific language to formulate matters or relationships between matters, which shall be free of logic conflict and let people realize understanding. If there is a scientific theory on consciousness, it shall be formed by scientific formulation without any mystery and shall be made understandable to the public. This prompts us to focus on two processes, of which one is the process of formulating scientific explanation; the other is the process of understanding the nature of scientific explanation. We have to reflect on what scientific language can formulate and how people can realize understanding from scientific language. If there is limitation on scientific formulation or understanding to scientific formulation, we need to reflect on what such limitation means to us.

The qualia basis of science

Science, built on physics, represents the most trustable and the most profound understanding

of human to the world. According to modern physics, today's world was born in the Big Bang 13 billion years ago. The Big Bang results in cosmic expansion and matters attract one another through gravitation and form structures of nebula, star and galaxy including the solar system and the earth that we live. The earth has appropriate natural conditions such as atmosphere, temperature and water etc. Upon origination, life evolved for a long time and finally formed numerous and vibrant worlds of life on the earth. However, all things on the earth, whether mountains, rivers, animals, plants or buildings and cars are matters that consist of more than a hundred chemical elements. And all elements are formed by atoms. Fixing our sight on a cat, we see its head, body, tail and skin etc.; going deep into them, we see bones, flesh and organs etc.; going deeper, we see blood vessels, cells and protein etc.; going deeper, we see molecules and atoms. For any object, we finally see nothing but molecules and atoms. Imagining we are as large as atoms and wandering in every corner of the earth or every inch of space in outer space, we can see endless atoms constantly oscillating, transmitting, gathering and dispersing besides void. This is the most realistic picture about nature depicted by physics. In this picture, all things are reduced to nothing more than atoms.

However, we may suddenly have a doubt that why the world depicted by physics is a giant picture instead of a mess of complex sound or a mess of odors or a batch of smooth or rough texture? Why we "see" the nature of the world instead of "hear", "smell" or "touch"? This leads us to realize that the world depicted by physics is visual! In this physical world, we see no other sensory characteristics: sound is disappeared, tone is nothing but various frequencies of motion of particles, loudness is nothing but amplitude of motion of particles and timbre is nothing but combination and distribution of sine-waves; the sense of touch is disappeared: the smoothness and the roughness is nothing but various forms of distribution of molecules on surfaces of objects; the sense of taste is disappeared: all tastes are nothing but chemical molecules with various spatial structures. Even with respect to the sense of vision, the perception of color is no longer existed: all colors are nothing but oscillation of photon in various periods. In other words, only vision is needed for understanding the world of physics, and that only a subset of vision for sensing length, shape and motion is required. If our world of physics is based on vision and vision is the most powerful organ of human, are these two facts coincidence? If vision is not the most powerful sensory organ of us, will the world depicted by our science be still a picture?

Let us think about the bats. Different from human being, audition is the major sensory modality of the bats and the information obtained with their vision is very limited. Suppose it was the bats instead of the human being that developed intelligence in the process of evolution and ruled the earth and built rigorous science on the deep understanding to the world. Then, how does the bat that is mainly with audition and detects the world with echo establish the knowledge formulation about the world? Facing to mosquitoes, the bats hear wake and fluctuant echo; facing to walls, the bats hear clear and stable echo. Different objects correspond to echoes with different characteristics. With these echoes, the bats establishes a basic description to the surrounding world, whereas this description should take characteristics of echo such as rining, chaotic, resounding, stable and oscillating as the language of description. The intensity and the frequency of sound emitted by the bats are limited, the bats' sound receiving ability is also limited and the spatial distance and forms of objects that can be detected are also limited. However, with development of the bats' science, they begin to make more powerful instruments for producing sound and detecting echoes. One can imagine that they use instruments to give

multiple beams of sine-wave and resolve echoes reflected from objects, and then obtain the spectrums of echoes and determine natures of objects. Similar to human, they can also produce accelerator to make objects collide at high speed and smash, and then analyze the composition of object according to the sound of objects after collision.

The bats can also distinguish long and short bars with the vision, but they would rather give ultrasonic sound and easily distinguish with echoes than difficultly distinguish with their poor vision. Different from the bats, we human can distinguish long and short bars by taking a glance at them without having to close our eyes and knock with a stick, and then distinguish long and short bar from the sound of knocking. With this imagination, the world structured by bat scientists would be an acoustic one and the basic unit of their language of science would be “phonon” defined by frequency and loudness and all matters would also be reduced to phonons. For the bats, the nature of the world would be a great mess of sound comprising of infinite phonons resounding throughout the universe.

One can also consider animals with touch or smell as the major sensory organ. The instinctive sensing abilities of this kind of animals may be more limited since they can only feel objects that their body can touch or odors within the receiving range of their noses. However, if there is enough time, they should also be able to product powerful instruments to explore things out of their touch and possibly establish a scientific system with touch or smell as basic units. Certainly, no matter depending on vision, audition, touch or smell, language and words must be developed, and then can it gain the ability of accumulating civilization achievements and form scientific theories that are deepened gradually.

Modern physics suggests that the most fundamental unit of the world is quark. Though quarks are point particles, they have some abstract characteristics such as spinning, charm and strangeness number, so it is hard to say they are pure visual concept. This seems in conflict with the viewpoint that physics is established on visual attributes, but one shall notice that physics is an experimental science and these abstract attributes are indeed depicted with observation and measurement of laboratory apparatus. What indeed recorded by apparatus for particle physics such as bubble chamber are nothing more than visual characteristics of length, angle and shape etc. In this way, the core concepts of science may not be totally visual or they are a kind of pure mathematical abstract that is unrelated to any sensory organ. But for understanding these concepts, people still have to depend on visual sensing of measurement results of apparatus. Nobody has ever seen “force”, but people understood “force” from stretched springs. Though people can also experience “force” from the tension sense of muscle, physicists do not use body feeling to measure force. When boiling down to the process of understanding, human physics is still visual.

Science cannot explain consciousness

A brand new understanding can be brought if science can be built on various kinds of sensation: though bats and human beings live on the same world, the methods that different species describe the world are greatly different. Not depending on sensory perception of any particular species and having absolute objectivity, the content of science reflects the causality among things, but the concrete form of science may depend on the species that builds science and depend on the nature of the dominant sensory organ of such species. It is most convenient and easy for describing information perceived by other sensory organs basing on the channel with the strongest information processing ability and the highest sensibility. The physics based on vision

describes other qualia with visual qualia such as size, spatial structure and motion. For example, the feelings of cold and hot are described as the kinetic energy of atoms; the feelings of red and blue are described as electromagnetic waves of different wave length. Similarly, the physics based on audition may describe other qualia with auditory qualia such as frequency and loudness. A specific species will take several kinds of qualia of its dominant sensory organ as the most fundamental construction elements or explanatory units of its science, while all of other qualia will become objectives to be explained or reduced. The reason why such explanation and reduction is possible is because science focuses on the results of interaction between matters instead of qualia itself. What is the result of a red-hot iron ingot after falling into cold water, the same conclusion can be drawn no matter describing or calculating by qualia of which sensory organ if only the corresponding science is complete. For example, human physics can provide sufficient description to the event only by concerning on the nature of motion of molecules of such iron ingot. Variation of the color qualia that the iron ingot turns from red into black can be deemed as an accompanying phenomenon that needs not to be concerned.

For human being, the scientific explanation is describing all things and processes with several basic qualia of vision such as length and shape, while these explanatory elements are within the range of perception of human being and can be understood by everyone with normal vision. For example, basic concepts of Euclidean geometry such as point and line are self-evident to human being because of the intrinsic similarity of human visual system. For other species such as bat, this kind of self-evidence may not exist at all. For another example, expressing basic magnitude relation with same, different, larger and smaller, stronger and weaker is essential for science, but when we say A is the same as B, we still need to base on direct experience. Without direct experience, we will not understand what is same, different, longer or weaker at all. The feeling that a one meter ruler is seen longer than a half meter ruler is most primitive and most direct. Consciousness and the qualia that this experience relies on are commonly owned by human being and self-evident without having to be explained. And they are foundations for us to understand everything and could not be explained by any other thing. Further, a precondition is that human being shall be able to communicate with one another, or the objective science cannot be established at all. The theoretical structure for final establishment of science is very complicated, but each specific explanation can be resolved progressively and reduced to the basic explanatory unit. Therefore, people can also gradually understand from simple add, subtract, multiply and divide to the most abstract scientific structure of the theory of relativity and quantum mechanics etc.

In this way, the answer to the problem that whether or not science can explain the qualia of red emerges. If all explanation of human science is based on several most fundamental qualia of vision, including point, line, shape, distance, orientation, speed etc., then explaining qualia with science is just letting people comprehend other qualia with those fundamental qualia. Then can qualia of point and line explain the quale of red? The answer is necessarily negative. According to the definition and people's understanding of qualia, they represent perception of different natures, have different essences and are incommensurable. Two incommensurable things can neither be compared nor measured with one and the same standard. Quale, the singular base form of qualia, is derived from the Latin root *quails* that means "variety". The English word quality derived from it with the meaning of "nature and characteristic". As a matter of fact, philosophers never intended to answer questions such as how long is red or is fragrance nice to hear. When Descartes points

out objects such as table has spatial location, size and weight, while people's thought has no location, size and weight, he is actually saying that different qualia are incommensurable: the feeling of red cannot be measured by length, size and weight.

Colors and odors are typical qualia often mentioned by people because their feelings are much different from basic visual feelings. As a matter of fact, there are numerous qualia in wide varieties. Human can distinguish thousands of kinds of color. Putting two colors with minor difference together, one can also find that they give rise to different feelings. Human can distinguish more shapes. Sense brought by any shape such as triangle is not the same with that of other shapes such as quadrangle. Therefore, there are already many qualia by only considering two visual dimensions of color and shape. All senses of our sensory organs such as thirsty sense, tension of muscle, anxious sense, pleasure, anger, sorrow, joy, sense of dream, sense of same and different when comparing sizes of two objects, and more abstract sense of happiness, sense of jealousy, sense of justice and even sense of freedom of will and self unity are qualia. Each qualia is a kind of intuitional direct given and cannot be understood with other qualia.

Human science takes visual qualia as basic units and other qualia are functionally reduced. Human brain becomes a collection of massive atoms. The stimulation of sound is understood as the oscillation of atoms causes fluctuation of atoms in brain after it is transferred into brain. However, all interactions are actions between atoms and shall result in nothing but variation of positions and motions of atoms. Human cannot understand why a quale of melodious sound appears when the information is processed to a certain degree. Similarly, the bats' science takes acoustic qualia as basic units and other qualia are functionally reduced to phonons. Their brain is also a collection of massive phonons and full of buzz. For the bats, a quadrangle is nothing but a set of specific sound waves. These sound waves get into brain and interact with other sound waves that form the bat's brain, but all interactions shall only change the characteristics of sound wave. The bat cannot understand why it has the feeling of seeing a shape with eyes. For human, it is impossible to reduce the feeling of sound into visual qualia just like that the bats cannot reduce the feeling of shape into acoustic qualia.

Scientific explanation must be with some basic units. These basic units need not to be explained and also cannot be explained. The above analyses show that these basic units are nothing but the qualia that we are baffled. The reason why these qualia can be accepted by everyone and become the basis for description and understanding in communication is because they are self-evident. In this way, though qualia are subjective, the reliability brought by their intuitive characteristic and self-evidence makes them become object and forms the basis of scientific objectivity. Daily explanation is the same as scientific explanation on using qualia as basic units, but the logicity, positivism, rigor and system of daily explanation is incomparable to that of science.

The biggest difficulty for reductionism to explain consciousness with science is how to explain that human brain gives rise to the function of consciousness. As a matter of fact, consciousness is neither a function nor a product of brain activity. On the contrary, the structure and functions of human brain described by science are just products of human conscious activities. In our science, human brain consists of cells. But in science of the bats, human brain is a mess of sound without spatial structures like cell, axon and dendrite. Going deep into each part of brain, all what bat scientists hear are fine sound. In addition to human brain, the whole world depicted by science is built on qualia of consciousness. Not only consciousness cannot be reduced to science,

on the contrary, science shall be reduced to consciousness. The primary existence of the world is qualia. And the phenomenal consciousness formed by qualia is the foundation for all scientific description and scientific understanding such that it cannot be reversely described and explained by science, namely it cannot be explained by science. That is to say consciousness shall not be a subject of scientific research. The existence of bats that are good at using echoes enables us to imagine a sound-based science and realize that science is based on qualia so that an “echo argument” is formulated for the conclusion why science cannot explain consciousness.

There is no consciousness in the framework of science

Science provides us the most reliable knowledge and the best forecast for the world. There is no other framework more reliable than science. Science is indeed the greatest outcome of human rationality, but the framework of science excludes consciousness and seeking consciousness therein is futile. Within the framework of science, both reductionism and materialistic viewpoints of monism are exactly correct: everything can be reduced and the world of science has and needs no spirit and qualia but interaction between matters.

In view of this, though different from a snake cannot swallow itself and a finger cannot point to itself, it poses no paradox that human brain is studied with human brains. In scientific experiments, scientists will not be observers and objects of observation at the same time. What studied by scientists are brains of other people, while such brains, the same as any other natural objects, are pure physical.

Also, from the perspective of science, statements that consciousness is generated when species are evolved to a certain phase or infants begin to have consciousness from a certain period are logically wrong. If considering that consciousness is not existed on germ but on human, it will give rise to a problem that which phase on earth was consciousness generated in the process of evolution? Likewise, a fertilized egg will successively grow into a fetus, an infant, a child and an adult. If considering that consciousness is not existed on a fertilized egg as a single-cell but it is existed on an adult, one may ask which phase on earth is consciousness generated in the process of growth, whether on a fetus of several months or on a baby of server years old? Almost all philosophers and scientists are great baffled by this kind of problem essentially because they are unanswerable pseudo-problems. Since the whole evolution process from germ to human being and the whole growth process from a fertilized egg, a fetus and an infant to an adult are scientific descriptions, consciousness should not be further involved in these descriptions at all.

Certainly, some significant events indeed happen while a fertilized egg grows into an adult and germ evolves into human being, but the core of these changes is intelligence instead of consciousness. In facts, functional consciousness reflects cognitive processing, so it cannot be called true consciousness. For example, when putting aside qualia but focusing on functions, self consciousness reflects intelligent agents’ abilities to access internal information processing. All mental phenomena and processes such as cognition, attention, working memory, intention, faith, motivation, emotion and self awareness can be described and studied in the pure information processing framework and need not to resort to subjective qualia or consciousness. Psychologists need not to abandon all glossaries related to subjective feelings, but they must be aware that the use of such glossaries is just for convenience: “the subject feels red” is nothing more than a simplified scientific description that “the subject made the response of “yes” when an acoustic stimulation “do you see red?” was given”. Psychology, as a science, is essentially built on

observable indices such as subjects' behaviors and does not really need qualia.

Likewise, the statement that consciousness is a kind of special form of neural activity or emerging characteristics of complicated systems such as nonlinear system is also logically wrong. Taking the perception of color for instance, neuroscience shows that the electromagnetic wave emitted by a colored object firstly stimulates cone cells on the retina, and then through the thalamus to reach the visual cortex, and further projected to the association cortices of brain. Many scientists believe that there is some neural circuit or special neural activity and people will feel red when such circuit is activated or such activity appears. This circuit or activity is called neural correlate of the consciousness of red. In their opinions, the retina cannot be the neural correlate of consciousness of red due to its structure and activities are pure physiological without any miracle, so they tend to seek consciousness in higher cortex structures. In other words, they believe that consciousness is not existed in the retina but in the deeper part of the brain. Consequently, they ask on which level from the retina to the brain is consciousness generated. Obviously, the same as the question that which animal from germ to human began to generate consciousness, this question is also unanswerable. The retina, the brain and any complicated systems including nonlinear system are outcomes of human science, while there is no consciousness in the world of science. In the framework of science, it is meaningless to say brain or matters give rise to consciousness. With respect to the study of the neural correlate of red in laboratory, though it seems like studying subjective qualia, it actually studies reporting characteristics of internal state of body. What studied is still function. For function, asking which neural circuit is in charge of consciousness of red is the same as seeking the "carrying force" on a train. Though the carriage seems the most important to loading, the "carrying force" is null without wheels, locomotive and rails.

Conclusion

Science is spectacular, but the previous view on science is over absolute and regards the world depicted by science as the world itself. As a matter of fact, we may never know the world really is. Basic units of today's scientific theories such as force, atom and quark are rational structures based on characteristics of human vision. As for what is the origin that they represent, we may never know. One day, a new scientific theory may be proposed and everything is explained again without needing the Big Bang or the theory of evolution. The form that science formulates the world is relative. We can build the image of world only on the basis of our sensory organs. In this way, science is closely related to its builders. And scientific knowledge is also indivisible from its builders and those who understand it. The world without the perceiver is chaos and cannot be discussed at all. The world can be discussed, be no more chaotic and shows structures and regularities only when there is a perceiver and a viewpoint. And only by then these structures and regularities form information for the perceiver. In this sense, the world is defined by the perceiver. The perceiver and things to be perceived are mutually dependent. However, what is the perceiver, why it can perceive, where does qualia come from and why they are numerous and diversified, all of these questions are unanswerable. Only with perceiver can there be feeling and language, understanding and explanation, rationality and wisdom, systematical exploration and accumulation and science. Physicists in the 18th century had to admit that perpetual motion machine can never be produced; 300 years later, it may be the time of seeing the limitation of science and admit that consciousness cannot be explained by science.

Inside science, there is no consciousness. Outside science, what can we say about consciousness? Descartes' dualism depicts discrimination of "matter" and "I", which well meets people's intuition. If "I" is understood as the aggregation of all qualia (including the sense that "I" am a spiritual unity), this "I" is gradually expanded and enriched. For example, "I" acquire many new qualia in growth and travel. In this way, it seems there is indeed a world of matters outside "I" and it is obvious that the relationship between "I" as the perceiver and "matters" to be perceived and known is not equivalence. Seen from the point that perceiver is not equivalent to the world, the simple idealism suggesting the world is equivalent to "I" is unreasonable. However, from the angle that the perceiver is the aggregation of qualia and things to be perceived and known are always represented as qualia, it also lacks of reason to believe "I" am essentially different from "matters", so dualism cannot be deemed as correct. Then whether the world is monistic or dualistic, or there are other answers? Maybe this question is unanswerable. There are also many similar questions, e.g. is there other perceiver beside "I"? Whether stones and insects are able to know? Does knower has spirituality? Is spirituality imperishable? Is the world designed or naturally occurred? Facing to these questions, everyone can select a stand and hold a viewpoint on the basis of his or her own faith. All of these stands and viewpoints are acceptable due to they are outside science and not in conflict with science, so it also needs not to judge right or wrong.

When everyone makes selection, isn't he or she selecting freely on the basis of his or her own will? Freedom of will is a kind of faith that people think they can select their own behaviors. The same as all faith, the feeling that people feel they have free will is also a kind of qualia. Same as all qualia, the origin of this quale is incomprehensible or unexplainable. Freedom of will means we can imagine that we quit present behavior and start another behavior at any time. Therefore, the core of freedom of will is imagination, while imagination is closely related to memory. The reappearance of qualia experienced before is just memory. Such reappearance may be partial: one may now only image the face of a man recognized yesterday. This indicates that multiple qualia brought by a specific experience are separable. This separable characteristic means for example the feeling of red can be separated from object and exist abstractly. In this way, different previous qualia can be recombined to form new fictional qualia such as a dancing towel on the basis of memory. Like the imagination that can be assimilated to "daydream", the dream is actually a kind of fiction that body carries out on a lower level of activity. Then how the fictional things exist? Are they real? Are things in dream unreal? Can one say fictional things are real in the sense that they can be experienced and talked about? These problems result in the thought of Zhou Zhuang's dream of butterfly and aroused Descartes' doubt to certainty of everything and also bring great bewilderment to many people.

However, seen from the perspective of echo argument, the most basic units of the physical world such as force and quark are artificial structure. There is no essential difference between correct and wrong scientific theories and concepts since all of them are fictional, except for the former conforms to our observation to the nature more than the latter. If the physical entities such as fundamental particles that people believe the most real are fictional, the fictional things are no more mysterious. And fiction is nothing but one of numerous qualia of human and does not form any new form of existence beyond qualia. The ethereal sense of fictional things is not harder to understand than the vivid sense of color or the melodious sense of sound. The really mysterious and unimaginable thing might be why we can recombine qualia and carry out fiction through imagination. This is equivalent to ask why we can build science and why we can understand

everything. All of these questions may be answered with a quote from Einstein: “The most incomprehensible thing about the world is that it is at all comprehensible.”

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