Sociology Mind
2012. Vol.2, No.3, 251-254
Published Online July 2012 in SciRes (http://www.SciRP.org/journal/sm)

Scientific Research
DOI:10.4236/sm.2012.23033

The Mind's Irreducible Structure

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Received February 6th, 2012; revised April 2nd, 2012; accepted May 5th, 2012

The human mind is one of our most compelling subjects of scientific inquiry—and perhaps our most elusive. Despite impressive biological advances, neuroscience has yet to produce a logical and empirical analysis of the mind that exhibits universal, objective explanatory power of human mental phenomena on both an individual and species level. This article first explores the limitations of the current neuroscientific approach to the human mind and then argues for a reconceptualization of the relationship between human mental phenomena and the brain. Here I introduce a new interpretation of neuroscientific data and argue that this framework has the capacity to causally explain the link between social, psychological and biological levels of analysis.

Keywords: Mind; Social Reality; Symbolic Process; Biological Sociology; Social Psychology

Introduction

One hundred and thirty years ago *Nature* published Thomas Huxley's article "The Coming of age of The Origin of Species" in which Huxley celebrated the triumph of Darwin's theory of evolution over the epistemological opposition it once faced. Huxley's epilogue to Darwin's intellectual drama praised the spirit of theoretical advancement despite conflict in the reigning scientific paradigm and concurrently warned us that, "…it is the customary fate of new truths to begin as heresies and to end as superstitions". Furthermore, Huxley admonished, "it is hardly rash to anticipate that, in another twenty years, the new generation, educated under the influences of the present day, will be in danger of accepting the main doctrines of the '*Origin of Species*', with as little reflection, and it may be with as little justification, as so many of our contemporaries, twenty years ago, rejected them." (Huxley, 1880). Huxley was afraid that biology, the discipline which assumed its place in the scientific institution only after the introduction of Darwin's framework, would one day become dogma and leave the true spirit of science, logical criticism, by the wayside. This article reflects both Huxley's praises and fears; on the one hand it confirms that dogma has captivated, and thus arrested, one of our most precious frontiers of scientific inquiry, and on the other hand it suggests that the progressive, intellectual spirit of science has the capacity to resolve our impasse as we strive to understand the *res cogitans* of our biological brains.

It goes without saying that the sophistication of our modern technology has brought researchers closer to the active, thinking brain than Huxley or Darwin could have ever imagined. We are able to parcel and analyze the structure and function of the human brain down to a molecular level of detail; we understand many neurological pathologies as never before; we observe the seats of memory and language in action; we even regulate emotion—the list of productive enterprises rooted in the biological understanding of the brain is impressive. Science does not understand, however, our brain's most amazing, and arguably its defining, feature: the mind.

In March 2010 at The College of the Holy Cross, a group of neuroscientists and philosophers gathered for a conference focused on the biological foundations of morality. During the discussion, keynote speaker Michael Gazzaniga, a neuroscientist, was asked to account for a distinction between the brain and the human mind. Gazzaniga responded, "You can stop any neuroscientist in his track… by asking the question, 'what is the mind?'. We all start to babble. That just says how hard the problem is. I like the answer 'the mind is an inference'. That's what it is."[1] I'm sure the author of this statement would agree that his answer is not a scientifically viable one. After all, Gazzaniga admits that neuroscience does not have a definition for the mind. This is because neuroscience hasn't *needed* to account for the phenomena of the mind in order to progress in the structural and functional understanding of the brain. The luxury of ignoring the concept of mind is temporary however, and serious neuroscientists know that for a comprehensive science they must account for *or* explain the mind in a scientific way. The *status quo* is such that, when forced to take the mind into account, responses adopt the uncomfortable, unscientific qualities of being personal, subjective and irrational—they take us beyond the limits of scientific discourse. Depending on one's persuasion, argument takes the form of either philosophizing about the mind on one side or reducing it to matter on the other. The centuries old schism between idealists and materialists persists and one is obligated to choose a side.

Proposals for Resolving the Dualist Paradox

But what if one chooses neither side? University Professor at Boston University Liah Greenfeld, a sociologist who has spent the past 10 years analyzing this epistemological quagmire, is now providing neuroscience with a solution by mandating such non-partisanship. She first stated her position in 2001 in correspondence with Eric Kandel in response to the book that details his Nobel Prize winning research with Larry Squire. Green-

[1]Quoted from keynote address "Brains, Beliefs and Beyond" March 18, 2010, CREC—Biological Foundations of Morality? College of the Holy Cross, Worcester MA. http://forum-network.org/lecture/michael-gazzaniga-brains-beliefs-and-beyond

feld's criticism simply points out the logical fault in reducing the phenomenon of human thought to the molecules that support it as professed by Squire and Kandel in *Memory*: *From Mind to Molecules*. The phenomena of our mind, according to Greenfeld, cannot be *explained by* the existence of our brains because, she asserts, the two processes seem to consist of different types of facts which are not translatable into one another from the bottom up (Greenfeld, 2006). The laws of biology of course, govern the structure and function of the brain, *but the biological characteristics of the brain are not positively determinant in any instance of the mind*. That is to say, it is not my American brain that determines my English speaking thoughts contemporary with the paradigms and trends of the 21st century, but rather the activities of a mental process underdetermined by all biological accounts.

This mental process could not occur without the human brain; the brain serves as what Polanyi calls "boundary conditions" for the activities of the mind (Polanyi, 1968). Remembering that a condition is not a cause, however, the problem arises that no quantity of data about the human brain itself *explains* the qualities of the human mind. It is the inattention to this logical confusion between condition and cause that has prevented the subject of mind from being incorporated into the purview of neuroscience. Greenfeld's new approach, however, comes not from negating the reductionist perspective, but rather from reorienting the focus of inquiry toward the nature of the mind and its connection to the biological brain.

The characteristic feature of the human mind is its *symbolic* nature. To understand the novelty of this hypothesis, and to make its formulation logical, one must recognize a symbol as an arbitrary referent whose meaning is derived from the context in which the symbol appears. Imagining symbols in this way implies that any particular symbol's meaning is always a matter of interpretation—as context changes over time, so too may the meaning of the symbol. This definition also implies that symbols stand in qualitative contrast to signs, which always appear in a one to one correspondence with their referent in the environment and are timeless in their meaning.[2] The biological world consists of a dynamic material environment and organisms to which the environment signifies. We know this from Darwin's framework which illustrates that the complexity of signs increases with the complexity of the environment and thus requires a proportionate level of adaptation for the survival of a species. What Greenfeld reminds us in the case of the human mind is that an increase in complexity never explains a break in continuity, and symbols constitute a reality *of their own kind* in juxtaposition to the reality of signs. The human, mental world is made up of symbols, facts that have only an arbitrary connection to their referent in the material environment and have no necessary consequence for our biological survival.

The primacy of symbols in human experience becomes immediately apparent when one ponders the example of language, our chief symbolic system. Words are symbols, that is, their meaning is never absolute. They are the facts of a creative, mental process and in every employment, our words must be continually reinterpreted based on an ever-changing context. Though this process is individual (i.e. language is always manipulated/symbols are always interpreted by one mind), words most often are acquired from or given to other minds. No individual is thought to be responsible for creating *de novo* all of the words that they employ. Instead we use words and ideas that are made available to us by our society and give them specific meaning by embedding them in the contexts of sentences and scenes. It then follows through the example of language that one can see Greenfeld's second pivotal hypothesis about the nature of human mind—it is a process made of up symbols *that are simultaneously individual and collective*.

The symbolic mental process that is the mind is only active in individuals but never exists in isolation from the commonwealth of symbols that is shared across distances and generations. No mind is an island. The infant brain does not build a mind from scratch relying solely on biological programming, but instead develops with input from its particular symbolic environment. We acquire our local language, are taught customs and slowly begin to participate in our uniquely human ways of life whose variation across our species cannot be enumerated. The uniqueness of this process lies in the fact that, unlike in any other species, it is *indirect learning* that occurs when the younger members of our species individualize knowledge from the symbolic commonwealth. The symbolic nature of the transmission of the human way of life therefore creates a reality that is not possible in the world of signs; one in which facts do not have to be experienced materially in order constitute a reality for us.

Greenfeld insists that one must merely recognize the verity of the mind's existence (after all, she reminds us, it is the only certain knowledge one can have) and then it can be operationalized as a mental process governed by the laws of symbols. Greenfeld states that our mental reality is a uniquely human process made up of symbols that, once externalized, become objective fact—i.e. they exist. These facts are definable by the complex matrix of context in which the symbol was employed. Like any dynamic biological process, the symbolic process is never static; despite this dynamism, the meaning of any symbol is discoverable so long as there exists sufficient contextual evidence relevant to the subject in question. This method of analysis can be imagined as analogous to biological analysis on the cellular and molecular level. The presence and effect of any particular cell or group of cells in a biological system can only be detected and subsequently explained when sufficient contextual evidence about the subject is empirically accessible in the system. Similar to organic reality, the number of forces that may be causal or effectual in the symbolic environment is enormous and the discovery of new evidence contributing to the retroactive explanation of a symbol is always a possibility. Therefore, in a manner parallel to that of the hard sciences, authoritative explanations of facts in the symbolic environment are the products of only the most logically consistent and empirically supported chain of causality. One can consider the analogy of Darwin's finches as an even simpler example; the distinct characteristics of a species' beak become logically significant only when analyzed in relationship to the finches' environment, i.e. when analyzed in the framework of Darwin's law. When one accepts the reality of the mind as a symbolic process and treats its phenomena as such, the facts of the mind (or, facts in the symbolic reality) become subject to logical and empirical analysis through the accumulation of circumstantial evidence that allows one to make hypotheses and refutations according to the laws that govern the system. Symbols, as facts, can be explained by discovering and analyzing the context that contributes to their

[2]For a detailed discussion on the distinction between symbols and signs, see Deacon, The Symbolic Species: The co-evolution of language and the human brain. W. W. Norton & Co. (1997).

particular nature just as Darwin could explain the characteristics of a particular finch's beak in the context of the environment. Greenfeld, therefore, makes possible logical, scientific inquiry into the human mind.

The Mind as an Emergent Phenomenon

Thus far, one might begin to think that Greenfeld has neglected the brain and chosen only a part of the dichotomy in the mind versus brain debate. This, however, is not the case. In addition to her revolutionary conceptualization of the mind as a symbolic process, Greenfeld has a logical solution for the connection between mind and biology—to treat the mind as an emergent phenomenon. To appreciate the nuance of this solution, it is helpful to consider the only other emergent phenomenon that we subject to logical and empirical analysis: Life as defined by Charles Darwin.

Huxley, in his "Coming of Age" address, noted the intellectual opposition that Darwin's *Origin of Species* faced after its publication. This opposition was a result of the scientific climate of the time which could not incorporate the phenomenon of Life into to a logical and empirical analysis. The problem that Life posed to Darwin's contemporaries in many ways resembles the problem of mind for modern neuroscience; its explanation was hindered by the dichotomy between the materialists and the vitalists (i.e. matter vs spirit). The physicists, chemists and naturalists of the time could not agree on the *origins and the nature of life itself*. Debate took the position of either reducing life to its material (physical-chemical) constituents or believing in the intervention of a divine creative force. As such, Life could not be defined and its nature and functional laws could not be investigated and explained; that is, until Darwin's *Origin of Species* operationalized the scientific study of life by treating it as an emergent phenomenon.

In The *Origin of Species*, Darwin laboriously demonstrated his law by which all biological reality abides: evolution by means of natural selection. What was revolutionary about Darwin's approach, however, was that his law transcended, and yet remained perfectly consistent with, the laws governing the physical universe (i.e. physics and chemistry). Darwin described Life as a process of evolution through natural selection both autonomous from and logically consistent with the boundary conditions of the material environment. This postulate neither reduced Life to its material constituents nor required empirical knowledge of Life's creation but rather took the organic reality for granted and operationalized its functional characteristics in a logical, scientific analysis. Darwin conceptualized and described the phenomenon of Life as a reality of its own kind, *sui generis*.

The illustration of Darwin's epistemological advancement was implied in Michael Polanyi's 1968 *Science* article, "Life's Irreducible Structure". In his article, Polanyi argued that DNA is a structure whose informational significance only exists because its ordered, code-like structure is not "due to the forces of potential energy". Polanyi tells us that it is the indeterminate nature of the base sequence that creates the informational essence of DNA in juxtaposition to the physical-chemcial probability that joins inorganic molecules in complex and regular arrangements throughout the physical universe. Thus, while the DNA structure occurs within the physical-chemical boundary conditions of its material constituents, the significance (both functionally and analytically) of any particular instance of DNA is extraneous to the laws of physics and chemistry; it is rather an informational structure in the process of life, determined not by physical laws but rather by Darwin's law—millennia of evolution via natural selection (Polanyi, 1968).

By stepping back from the detailed, molecular and cellular focus of modern biology, Polanyi reminds us that the biological reality, as conceptualized by Darwin is *a reality of its own kind* whose laws are extraneous to the physical-chemical boundary conditions in which the process of life takes place. All organisms, according to Polanyi, exist as systems of dual control in which the structure of the organism is bound by the laws of physics and chemistry while at the same time the developmental processes, or morphogenesis, of the organism will organize its inanimate constituents in ways that both limits and defies the probabilities of inorganic, physical-chemical interactions (Polanyi, 1968). Life abides by its own organizing principle which is irreducible to but perfectly consistent with the laws of inanimate matter (life's boundary conditions); understanding life as this autonomous and organizing principle was Darwin's revolutionary contribution to science.

Greenfeld proposes to deliver a parallel theoretical advancement to human neuroscience by treating the mind as an emergent phenomenon. The reductionism of evolutionary psychobiology, according to Greenfeld, cannot explain the origins of the human mind just as Polanyi points out that the reduction of biological structure and function cannot explain the emergence of the organic process. *This is because the constituent elements of both phenomena only become analytically significant when they are already engaged in their respective processes.* In both cases, (the mind and the organic reality) it is not necessary to explain an origin in order to operationalize a logical and empirical analysis. Recognizing the independent and organizing properties of the system, however, bestows significance upon the data within system. For Polanyi it is the reality of the organic process that organizes the physical-chemical elements of biological systems; for Greenfeld, it is the reality of the mind that organizes the biological processes of our brains. Once we recognize the mind as a real process of its own kind with its own laws—the laws of symbolic reality—that exist independent from, but consistent with, the boundary conditions of our biological brains, we then open the possibility of mapping the principles of the mind onto the structural and functional organization of the human brain.

Memory from the Top-Down?

As a thought experiment, let us consider what we already know about memory and cortical organization through the lens of this framework. We know that in the instance of long term declarative memory the hippocampus is a necessary structure in the consolidation and recall of complex matrices of data (Eichenbaum, 2000). In any given life experience there is an enumerable amount of stimuli that are present and only a small fraction of all possible stimuli enter into the conscious attention of an individual and become the sensory pieces of a complex long term memory. During this process the hippocampus coordinates a wide network of disparate sensory modalities and facilitates their association into a consolidated memory experience. It would be illogical to think of this neurological system as creating memories because the existence of a memory is predicated on a stimulus (a thing remembered); this is simply a description of the neurological system which supports the phe-

nomenon of memory in an organism, as such, this description is entirely based on the biological laws of complex nervous systems responding to the signs of their material environment—it is not yet human specific.

In the instance of human long-term declarative memory, however, we do not merely store and recall interactions with our material environment (signs). We store and recall interactions with our symbolic environment. In fact, *all of our semantic memory is symbolic*—and thus, I would argue, the vast majority of our episodic memory is symbolic too. When we recognize the reality of the mind as a symbolic process, it then follows logically that our long-term declarative memories are products of symbolic reality. Paris, France, is only Paris, France, because members of our symbolic commonwealth have deemed it so for hundreds of years. The interaction with this fact in both the instances of indirect learning and conscious recall is an interaction with symbolic reality supported by, and thus physically reflected in, the biological mechanisms of our brain.

At this point, let us remember one of the primary characteristics of symbols: their meaning is never static but only determined by the context in which they appear. As such, we can logically deduce the hypothesis that though the brain physically reflects an interaction with this symbolic fact (i.e. that is, it is *real* on the biological and mental level of analysis because the mind cannot exist without its constitutive elements) there is no *specific and constant* neurological representation of Paris nor a "Paris cell" in the brains of individuals who learn, recall and manipulate this symbolic fact. One may remember the piece of information that Paris is the capital of France and one may also remember a trip, a novel, or a life in Paris. In any case, the mental experience and precise neurological manifestation of recalling the symbolic fact of Paris will be different for each individual—*perhaps even different each time within an individual*—who is only able to understand the symbol based upon the collection of symbols that one associates with Paris contributing to its defining context at any given time. Symbols, as I have pointed out, are associative by nature and, as such, our declarative memories are too.

To assert that our declarative memories are associative seems to be nothing new in the paradigm of neuroscience. We only understand the mechanisms of memory through the associative connections created by neurons that fire and wire together into networks that are then associated with other networks via the hippocampus constituting a rich memory. What is, in fact, different about the present assertion is that it has the explanatory power to account for the neurological representation of memory as a system that is associative *according to the laws of symbolic reality*. This is juxtaposed with the traditional neuroscientific approach which is logically incapable of describing the associative characteristics of memories by studying the neurological structure and function of the brain. Put differently, while neural networks do not constitute human memories, human memories (the symbolic process that is the mind), in fact, organize neural networks.

Ruminating on the normal instance of memory in light of Greenfeld's complex framework is a small thought experiment, necessarily limited by the scope of this article, but thought experiments of the kind are, in fact, the only means by which we can perform the intellectual activity of science. If she is right in her description of the structure and function of the human mind, even the most sceptical in neuroscientist might begin duplicating such thought experiments in his or her own work, quietly testing the possibility of a top down explanation in which the unique human reality, defined by its symbolic nature, organizes the structure and function of the human brain. This is because new ideas, Greenfeld tells us, are the most powerful force in our reality. Once a truly revolutionary idea is born, the idea itself becomes irresistible and an undeniable fact to all that it touches. As Huxley reminds us, however, new ideas are only dangerous when they are approached with little reflection and treated as either blasphemous heresies or absolute dogma.

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