The Biological Rationale for Revising Communication Theory: Mirror Neurons, Epigenetics, Brain Functions, and Lexicon-based Semantics

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Abstract: There are many recent changes in modern science that necessitate the change in communication theory. Mirror neurons demonstrate how by watching others one learns to mirror their behaviors; epigenetics provides insight into how the environment plays a major role in the workings of the mind; the role of the brain and its functions play a major role in how language is created neurolinguistically, and these changes also require a new model of language called lexicon-based semantics. Language, it is argued, is not generated by the brain, as Noam Chomsky (1965) argues, but works on the basis of a network of overlaid neural functions (auditory, visual, tactile, and sensory motor) that combine to form the various components of language (phonation, audition, reading, and writing). Instead of generating language as a mathematical language acquisition device (LAD), this model begins with semantics which includes the lexicon and it is argued that many structures already exist in the lexicon that demonstrate the presence of syntactic structures. Other components of this model include syntactic and rhetorical devices needed to account for linguistic variation. Consequently, communication appears to be exogenetic in that it begins with signals that exist outside of the human body and are received via biological receptors and collectors into the brain where it is processed and integrated into language and cognition. It is argued that even if a lexicon-based semantics were feasible, it would still need to deal with the more difficult problems of how logical forms are represented and interpreted in a biological model of language.

Keywords: Mirror neurons, epigenetics, motor neuron system, acoustic processes, visual processes, phonation processes, neurological receptors, lexicon-based semantics, the exogenesis of language, the exogenesis of culture, cultural scripts, and a biologically based model of human communication

1. Introduction

Communication is an interdisciplinary science. It incorporates information from a host of related sciences such as anthropology, sociology, physiology, linguistics, and so on. The model of human communication, however, is based on the metaphor of the railway system that was developed over two centuries ago.

The senders and receivers are based on the concept of railway stations and messages are sent from one station to the other by first packaging the message, sending it along the railway system (channel) and unboxing (decoding) the item at the next depot (decoding). If the package does not arrive at the second depot, the sender is notified by means of a feedback depot.

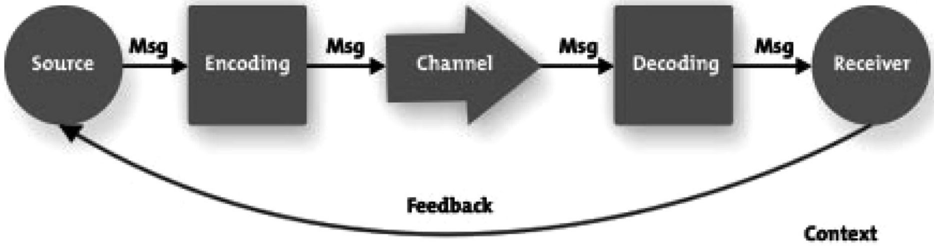


Figure 1. The Current Communication Paradigm

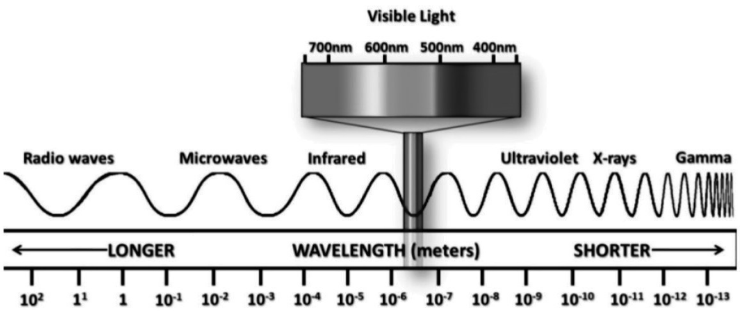


Figure 2. The Electromagnetic Spectrum

Feedback, it should be noted, is a more modern concept. It was invented as part of cybernetic theory during the Second World War. Another paradigm problem with modern communication theory is that it has not kept up with many of the recent developments in modern science such as mirror neuron theory, brain motor research, the embodied mind theory, and theoretical linguistics. What these disciplines demonstrate is that a speaker does send a message to a hearer but it is not encoded in words or signs, but in acoustic packets of information that are processed by the brain's auditory system. Information is also sent to a viewer by means of visual information that is further processed for color, shape, and movement and then sent on from the occipital portion of the brain to the premotor cortex system where it is processed for neuromuscular motor control. When it comes to the question of how the brain is controlled, it is argued that much of the constraints of brain functions are epigenetic. What this means is that the environment plays a major role in the creation of subconscious patterns of behavior executed by the brain. It is argued that only 5% of human brain functions are conscious and that 95% of these functions are subconscious. Most of these functions were learned early in life at a time when neural brain waves were functioning at the alpha brain wave state. In other words, what one learns about one's culture and behavior took place during the first seven years of one's life. From the study of epigenetics, it is learned that the human DNA plays a minor role in brain functions. Brain receptors play a larger role and these are connected to a wide range of signals of the electromagnetic spectrum that are located in the environment outside of the human brain. Humans are aware of only a small range of this spectrum. Touch, for example, can be felt at around 4-7 Hertz, sounds can be heard at around 4-20,000 Hertz and sight can only see things within 7-9 Angstroms units. Outside of these ranges, they lack the biological receptors to monitor these frequencies. A good place to understand these concepts begins with the study of the human cell and its parallel functions to the human mind.

2. Epigenetics

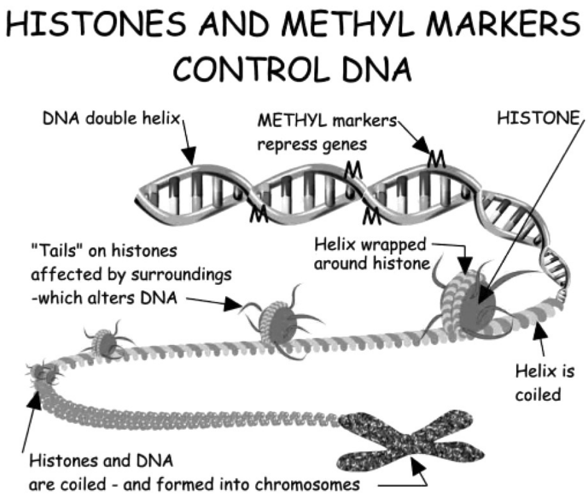


Figure 3. Epigenetic Control of Genes

Epigenetics has to do with the cellular and physiological phenotype variations. These changes are caused by environmental factors that switch genes on and off and affect how cells read genes (Francis, 2011). This theory challenges the argument that cellular functions are completely caused by changes in the DNA sequence (Wallach, Lan & Schauzer, 2014). Whereas genetics is based on changes to the DNA sequence (the genotype), there may be other causes for gene expression (cellular phenotype) such as the environment (nutritional factors, physiological state, emotional health, clean air, water, toxic chemicals, diurnal variations, disease, therapeutic drugs, and alternative medicine). Epigenetics has to do with cellular influences that are above or beyond genetics. Hence, epigenetics has to do with the interaction of genes with their environment (Carey, 2011). The term, however, also refers to functionally relevant changes to the genome that do not involve a change in the nucleotide sequence. Such is the case when repressor proteins are attached to silencer regions of the DNA. Hence these non-genetic factors such as DNA mythylation repress genes and histone modification causes changes in how genes are expressed (Moore, 2015). This is because both are epigenetic functions wherein mythyl markers repress genes and histones unwind the DNA double helix making the DNA sequence unprogrammable. These changes may last through cell divisions for the duration of the cell's life and it may last for multiple generations through the action of repressor proteins that are attached to silencer regions of the DNA. All of these functions occur within the cell which is the most basic unit of life. The human body contains millions of cells and DNA (deoxyribonucleic acid) is the hereditary material located within the nucleus of the cell and in the mitochondria. The information in the DNA is stored as a chemical code: Adenine (A), guanine (G), cytosine (C), and thymine (T). There are three million of these chemical bases in each human cell. These bases pair up with each other to form base pairs, AT and GT. When these base pairs are attached to a sugar or a phosphate molecule, they are referred to as nucleotides which are arranged in long strands that form a spiral known as the double helix. These DNA strands are able to duplicate themselves. This process takes place in cell division where each new cell has a copy of the chemical bases of the old cell. The gene is made up of DNA and functions as a basic unit of heredity. It contains instructions to make protein molecules. The Human Genome Project estimated that humans have between 20,000 and 25,000 genes. Every person inherits a copy of its gene from his parents.

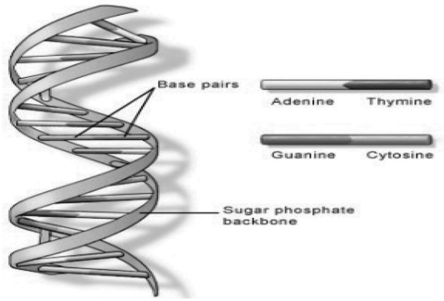


Figure 4. The Double Helix

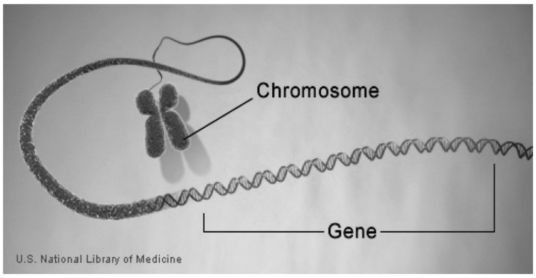


Figure 5. Human Genes

Why is so much emphasis being placed on the cell? How does it relate to human communication? The answer has to do with some interesting parallels between how the cell and the human brain function.

3. How the Environment (Epigenetics) Relates to Both the Cell and the Human Brain

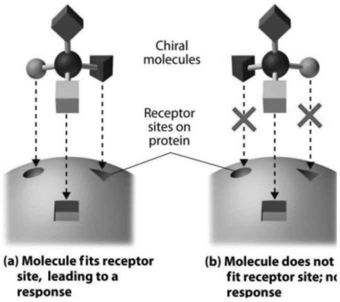


Figure 6. Receptor and Collector Sites

In 1962, the Nobel Prize in Physiology or Medicine went to Francis Crick and James Watson for their work on the discovery of the double helix as a molecule which is the foundation of heredity. Watson (1998) wrote about this venture and this discovery led to the Human Genome Project and the unlocking of the genetic code. At this time, it was believed that DNA was the molecule that controlled one's life; it was believed to be part of one's inheritance because it had the power to shape and control one's future genetically. Hence, it was believed that genes are an expression of an individual. In other words, it was believed that the nucleus of a cell controls the genes and consequently controls its expression. This hypothesis has been challenged by work in epigenetics (Lipton, 2006, 2015). The belief that humans are biomedical machines controlled by genes was not supported by the facts. It was discovered that genes can be controlled by their environment.

Bruce Lipton (2006, 2015) worked on cellular research with a particular focus on the cloning of stem cells. This work is important because every day millions of cells die and they are replaced by stem cells. Lipton wanted to know how this process operated. It was his job to enucleate cells, i.e., to take the nucleus out of a cell and to study its impact on how the cell functioned. It was believed that the nucleus was the brain of the cell. It controlled the genes within them. He found, to his great surprise, that when the nucleus was taken out of a cell, nothing happened. For several months the cell continued to live and to function as if it had a nucleus. He then went on to take these enucleated cells and place them in a culture within a petri dish. If the environment was neutral then the stem cells would produce new stem cells. However, if the environment contained brain cells, the stem cells would change into new brain cells. Similarly, if the environment contained muscle cells or fat cells, the stem cells would change in respect to these new environments. These facts led him to ask new questions about cell development. What, he asked, controls the cell when it has no nucleus? What causes these cells to continue to function? The answer has to do with the surface of a cell. It contains biological receptors and collectors that interact with the environment. If the shape of a molecule fits the shape of a receptor on the surface of the cell, then an interaction occurs and the cell responds with internal changes. That is why cells can live for several months with no nucleus at all. It is not the nucleus that controls the genes within a cell, but the biological receptors on the surface of these cells that allow interactions to occur. The belief that the nucleus is the brain of the cell is not a tenable concept. So what function does the nucleus have within a cell? It renews parts of the cell. It has a gonad function and not a cerebral one.

As a result of his research, Lipton (2006, 2015) concluded that genes do not control biology. It is the environment that controls biology. So what is the function of a gene? A gene, Lipton notes, is a physical blueprint to make a protein. They are nothing but blueprints to create a building block. Hence, genes are not the primal elements of life; proteins are the primal element. They are the primary particles of life and they are unique because they can change their shape. This is important because when a protein comes in contact with an environmental signal, they can change shape and move. This movement is used by the cells to cause work. In other words, life comes from proteins responding to environmental signals. That is to say, cells respond to factors that are above and beyond the genes, epigenetics. More clearly stated, human beings are protein machines that respond to environmental signals (pain receptors, thermoreceptors, chemoreceptors, and manoreceptors). The environment provides information that influences gene activity (aspiration, digestion, secretion, etc.). The study of how the environment influences the gene is called signal transduction. Genes do not control the body. Signal from the environment enter the body and activate gene behavior. The result of this process is the production of proteins that control human biological functions.

Lipton (2006, 2015) went on to note that the skin of an embryonic cell is called the epidermis. It constitutes the surface of the skin, the dermis. It is also called the ectoderm because it is found on the skin that is outside of the cell. Nevertheless, it is on the skin that one finds the biological receptors that influence cell function. It is interesting to note that in the human embryo, the epidermis folds over itself to create a tubular structure within the body that one associates with the human brain and nerve cells. In other words, the brain cells and nerves are derived from the epidermis of embryonic cells. This means that the human brain is a device that uses the embryonic epidermis or ectoderm to react to the environment just as cells do. There are only two kinds of cells that come from the ectoderm: skin and nervous cells. This means that the skin picks up information from the environment and translates it to the nervous system. There are 100,000 such receptor proteins built into the surface of each cell. These receptors open up channels so that signals can enter into the body of a cell and cause protein changes. This similarity between the ectoderm of a cell and the embryonic ectoderm of the nervous system fascinated Lipton.

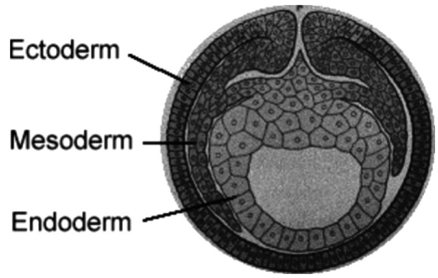


Figure 7. Epidermis or Ectoderm

If the environment controls what happens in a cell, what controls the human brain? The answer is dictated by the environment. What is the environment for the brain? It includes the biological receptors on the human body that pick up signals from the electromagnetic spectrum, namely, touch, hearing, taste, smell, and vision. However, there is another environment that influences the brain and it is internal to the body. It is the blood. It is like a petri dish in that it contains chemicals that influence what the brain does. For example, when one is in love, certain chemicals are released into the blood stream such as dopamine, oxytocin, pain depressants, and growth hormones. These chemicals come into contact with the brain and create positive behavioral changes that are associated with cell growth. When one is in fear of a situation, other kinds of chemicals such as stress hormones and inflammatory agents are released into the brain and cause negative behavioral changes that are associated with the demise of cells. How are these chemicals released into the blood stream? They are released by the mind when it perceives either love or fear. Hence, a positive or negative perception of the environment can affect brain function. One of the most interesting kinds of evidence for epigenetics comes from the study of identical twins. When they are born, they share the same environment. Later in life, if they are separated and live in different environments, they are no longer genetically identical. The environmental stresses that they encounter in life will change them.

Bruce Lipton (2006, 2015) went on to ask about the concept of the self. If the factors that control one's life come from the environment, then where is the self? Is it within the human being? He says that is not. It exists outside of the human body. He uses the analogy of a broadcasting station where human beings are the television sets or receivers. The information that one finds on television comes from the station that is broadcasting that information. Hence, if the television set is broken, the information does not cease to exist. These are very interesting questions that are being asked by some research biologists. This leads to the concept of morphic resonance.

4. Morphic Resonance

The concepts of morphic fields and morphic resonance and how they interact biologically with humans and animals are the focus of biochemist and biologist Rupert Sheldrake (1995, 1998) from Cambridge, England. Sheldrake argues that the laws of nature are more like a habit. Things happen because they happened before. Every species, he argues, has a collective memory and every individual in that species draws on that memory and contributes to it. This idea, Sheldrake, notes has radical implications. One of them is that the memories of human beings are not fully in their brains. This is because the brain is more like a television receiver. Although these ideas are rather controversial, he argues that they make more sense than the standard theories of science. This kind of memory works through a process that he calls morphic resonance (Sheldrake, 1995; 1998). It is expressed through fields, in particular, morphic fields which are self-organizing systems. They have been observed in the organization of cells and crystals. They also organize groups of organisms such as fish and birds (Figures 8 & 9).

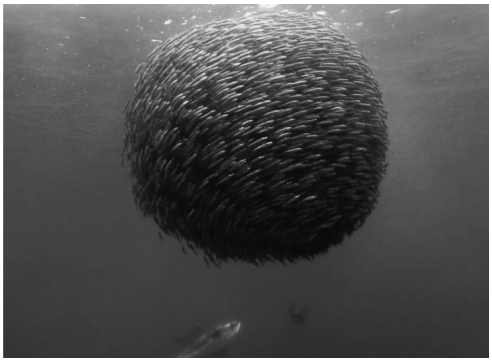


Figure 8. Fish Swimming in a Force Field

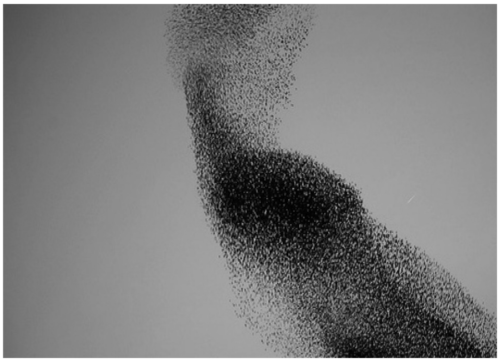


Figure 9. Birds Flying in a Force Field

These fields organize energy. Energy, Sheldrake (1995, 1998) notes, is one of the unifying fields of science. There is energy in nature that gives things actuality, movement, and change or flows. This energy flows through many different forms. This energy can be converted into other forms of energy. For example, the energy of light can be converted into chemicals in the trunks of trees. This energy, which he calls Shakti, takes many different forms because it is organized by fields. These fields are not themselves energy, but they organize energy. The concept of fields in science was introduced by Michael Faraday, an English scientist who contributed to the study of electromagnetism and electrochemistry during the nineteenth century (Faraday, 1993). He questioned how a magnet could have an influence on other objects (iron filings) at a distance. To explain this, he created the concept of a field, a region of influence. The field is inside the magnet, but it stretches outside of it. If one does not have iron filings, the field would be invisible. With iron filings, however, the field becomes visible.

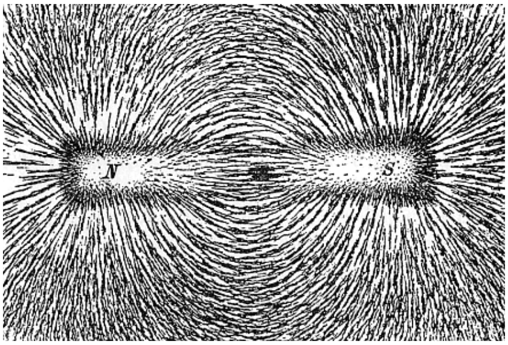


Figure 10. Magnetic Fields of Iron Filings

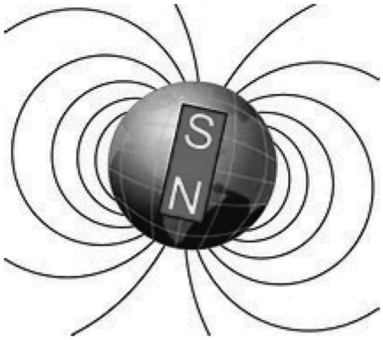


Figure 11. Earth's Magnetic Field

Faraday asked what these fields could be made of. He had two hypotheses about this. One was that fields were made of corporeal matter. The other was that fields were modifications of space, in other words—patterns in space. He chose the latter. Instead of fields being made of subtle matter, he reasoned that matter may be made of fields. Confirmation of this second hypothesis came in 1905 from Einstein's theory of relativity in which he argued that magnetic fields around the earth are not in space and time; it is spacetime (Einstein, 2012). Current research in physics attempt to explain these fields by means of superstring theory (Greene, 2003) and M-theory (Kaku, 2006).

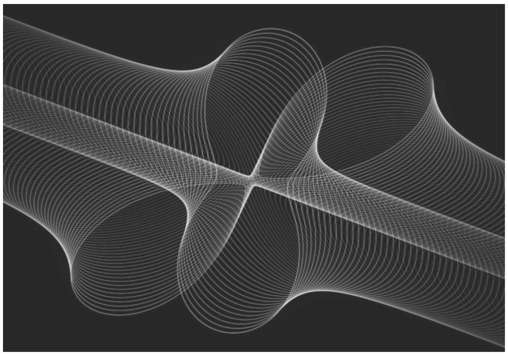


Figure 12. Articulation of String Theory

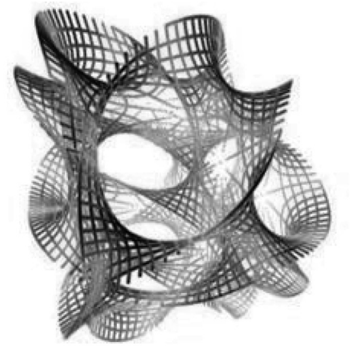


Figure 13. String Theory Image

Sheldrake (1998) notes that the morphogenic fields that he is arguing for are a part of a larger system of fields that include magnetism, gravity, M theory, and superstrings. Science, Sheldrake concludes, has moved on from materialism (Sheldrake, 2012). The world is no longer made of things; it is made of forms of energy. Morphogenesis (the coming into being of form) is a concept that he introduced to account for the fact that living organisms are shaped by these fields. This concept is needed to explain how animals and plants grow. It is needed to explain how new forms appear in nature. The form is not to be found within the ovum or the seed. He adds that these developments cannot be explained by genes. How does one explain that a person's arms and legs have the same proteins and yet they have different shapes? What is it that gives an organism its form? The answer can be found in the invisible morphogenetic resonance that underlies these forms. What makes fields interesting is that they are holistic. One cannot have a part of a field. It exists as a whole system. This is because fields are inherently holistic. For example, if one cuts into a willow tree, each cutting contains the whole tree. Fields are hierarchically organized. Nature is made up of many different levels. Hence, there is a nested hierarchy of structures. There is a field for the whole organism; there are fields for the organs within an organism; there are fields for the tissues within the organ; there are fields for the cells that constitute tissues; there are fields for the organelles within a cell; and fields for the molecules inside them.

Morphogenetic fields were introduced by developmental biologists early in the last century and they still constitute a research paradigm in that discipline. It was discovered at this time that these fields are modular. They create the shapes of parts within a system of resonance. Sheldrake became interested in morphogenesis when he was doing his doctorate in biochemistry at the University of Cambridge in England. He realized that chemistry could not explain how trees, plants, and animals take on various shapes. Chemistry cannot explain how similar patterns can be created over time and space. Only morphogenetic resonance can do that. Patterns exist over time and space that continue to resonate with each other. Sheldrake went on to demonstrate how this theory could be tested. One of the ways to illustrate how the theory works is by the disciplines of chemistry and crystallography. In essence, if one creates a new chemical and crystallizes it, a morphogenetic field will exist around that product. When one duplicates the experiment, the second product will be much easier to produce because the first morphogenetic field already exists and it is in resonance with the new chemical product. The process is cumulative as habits are built up in nature.

Sheldrake differs from Lipton on his concept of self. They both agree that the concept of self exists outside of a person but disagree on how it is organized. Sheldrake argues that each person has a morphogenic resonance with himself in the past and this is why people can remember things about themselves. Another form of evidence for these fields can be found in telepathy. This is found in humans (2013) and in animals (Sheldrake, 2011). There is even evidence of this in quantum physics. If two particles are part of a group and are moved apart, these particles are still related to each other and continue to function as a part of that system. They remain entangled (Greene, 2003). Nevertheless, Sheldrake (2011) looked into telepathy among animals. He documented how dogs knew when their owners were coming home and how they would wait by a window or a door for them to arrive. The evidence was overwhelming that such a morphogenic resonance occurred. He then turned to the study of humans and how they were aware that someone was staring at them (Sheldrake, 2013). Once again, the evidence was overwhelming. Even the military added further documentation by showing that assassins are taught never to stare at the people that they were assigned to kill because that person would be able to sense such an intent.

5. The Exogenesis of Language

Noam Chomsky (1965) argued that human beings are able to communicate with each other because they all possess a biological mechanism within the brain that generates language in the form of syntactic structures, lexical insertions, and transformational rules. All of these functions, he claims, are inherently genetic. His model has never provided biological and physiological proof of these functions. In fact, the opposite position can be argued that language is epigenetic. It is acquired and processed from the human environment and is often organized within the brain as overlaid functions. In other words, biological processors of touch, taste, smell, temperature, audition, phonation, and vision play a major role in language acquisition.

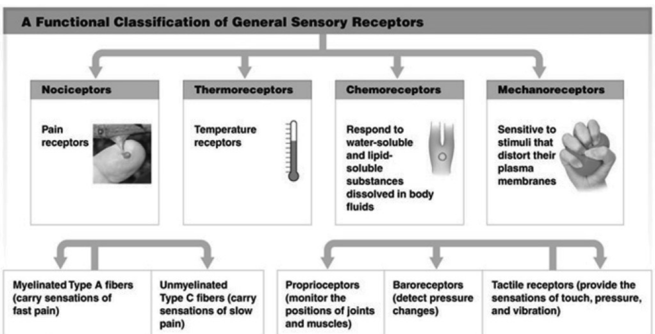


Figure 14. Neural Cell Receptors and Collectors

TOUCH. Most people can feel vibrations that vary between 4-7 Hz. There are a few people who can sense even lower vibrations and they can detect the movement of buildings during high winds or the early movements of an earthquake. Temperature is another proprioceptor function that is built into the human ectoderm. When one is warm, the skin releases perspiration and when one is cold, muscles under the skin are activated to generate warmth. Chemicals on the skin can produce a wide range of responses from softening of the dermis to itch, rash, and a burning sensation.

TASTE. Taste is another kind of biological device that samples the environment. The tongue is covered with small papillae (small bumps). Each of these contains multiple taste buds which sample for sweet, salty, sour, and bitter tastes.

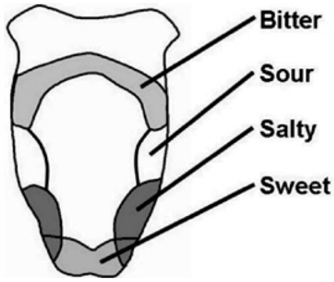


Figure 15. Biological Receptors

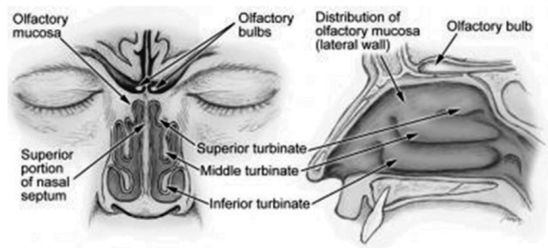
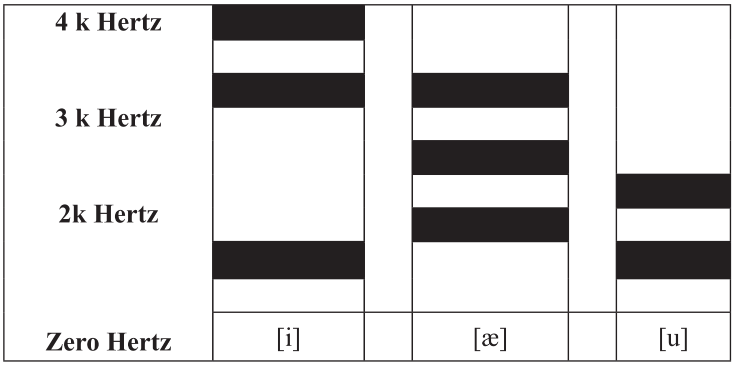


Figure 16. The Olfactory System

SMELL. Another stimulus detector that monitors the environment is the olfactory system (the sense of smell). The nose has two distinct parts that are used to detect odors. One is the main olfactory system and the other is an accessory olfactory system. The former detects volatile airborne substances while the latter senses fluid stimuli (pheromones). There are about 1,000 genes that are coded as olfactory receptors. Each of these receptor cells sends electrical signals to the olfactory bulb (glomerulus) which transmits this information onto the brain. Axons from the olfactory bulb send information to a number of brain areas: the piriform cortex (associated with identifying odor), the amygdala (involved with recognition of animals of the same species), and the entorhinal cortex (associated with memory). From an epigenetic perspective, all of these functions have to do with the ectoderm reacting to the environment. They are all forms of human communication which in some indigenous cultures have great significance. However, the two major forms of communication in modern industrial societies are related to speaking, hearing, and vision. Those are the focus of the proposed communication paradigm.

HEARING. When sounds are phonetically articulated, they create packets of acoustic information. These are sent to the ear where they are analyzed and further directed to other parts of the brain by means of the 8^{th} cranial nerve. When one pronounces the vowels [i], [æ], and [u], for example, three resonant chambers are created in the buccal cavity. The smallest, [i], has two smaller chambers and one larger resonating space. The smaller resonating chamber has a higher pitch whereas the larger cavities have resonated at a lower pitch. These resonant chambers in the buccal cavity form what is tantamount to musical chords. Hence, it is not surprising that the cochlea processes music in the same way that it analyzes vocalic and consonantal sounds in speech. These resonances can be duplicated in a sound pattern playback machine as evidenced below: The sound spectrograph that was invented during the war to monitor air plane engine motors were used later to study human acoustic sounds. Researchers at Bell Laboratories went on to invent a machine that could play back these sounds mechanically. The following is an example of how these sounds would appear on that pattern playback machine.

Table 1. Sound Pattern Playback Format



Once the acoustics of the human voice reach the human ear, they are subjected to a Fourier analysis in which complex wave forms are broken down into simpler vowel and consonant forms (Howell, 2001). This is accomplished by means of a range of hair cells in the cochlea that are connected to the 8th cranial nerve (the auditory nerve). This nerve goes to the pons from which it is further distributed within the central portions of the brain. These acoustic sounds correlate to a range of human phonation (consonants, vowels, fricatives, nasals, and pharyngeal) and music. These sounds are combined morphologically in human language. What is important about this overview of audition is that language is acquired exogenetically from outside of the human brain. It is not generated internally.

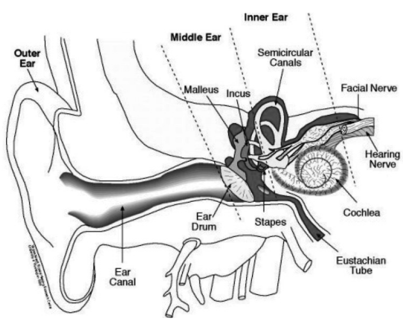
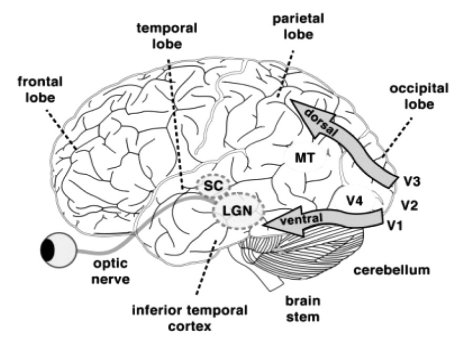


Figure 17. Cochlea & Cranial Nerve

VISION. The other biological receptor that plays a major role in language acquisition is the visual system. This is the part of the human nervous system that is able to process information received by the eyes. It directs and interprets this information as monocular representations and transforms them into binocular perception. When light enters the eye, it reaches a system of photopic cones (color) and scotopic rods (black and white) at the back of the eye and through a process of photochemistry, this information is sent to the optic nerve (the second cranial nerve) where it eventually is sent to the visual cortex. There are five major functions associated with portions of the visual system and they are referred to as V1 to V5. The first visual cortex area, V1, provides a well-defined map of the spatial information in vision. It is referred to as a reinotopic mapping because it transfers the visual image of the retina onto V1. The neurons within V1 have the smallest receptive field size of any visual cortex microscoptic regions. This portion of the visual cortex is associated with edge detection. The secondary visual cortex area has to do with visual associations and makes strong connections with V3, V4, and V5 and has a strong feedback mechanism with V1. The third visual area, V3, is associated with the third visual complex, an area that extends beyond V3 that has to do with visual memory and motion. The fourth visual area, V4, is tune to frequency, orientation, and color. The fifth visual area, V5, plays a role in perception and local motion signals (Table 2). All of this visual information is combined morphologically in human language as color, size, shape, movement, and foreground /background distinctions.

Table 2. Brain Functions of the Visual Cortex

Visual Cortex	**Neurological Functions**
V1	Edge detection, foreground vs. background
V2	Visual associations
V3	Visual memory and motion
V4	Visual orientation and color
V5	Local motion signals



Hence, what is important about this overview of the visual system is that language is acquired exogenetically, from outside of the human brain. It is not generated internally. This idea, that language is acquired outside of the brain, is not new. Over a century ago, Ferdinand de Saussure (1986) also made such a claim when he stated that language was comparable to a library where one went to borrow books. Next, it is argued that culture is also acquired from the environment in which human beings are situated.

If genes are activated by their environment (exogenesis) and if the human brain is stimulated by stimulus inputs from the environment, then how is language created? The position taken by Chomsky (1965) that language is generated by a language acquisition device (LAD) within brain is no longer tenable. There is ample evidence to demonstrate that language is not acquired by such a device but is composed of a network of related inputs from the environment that constitute a neural linguistic system. These inputs come from audition (acoustic inputs), vision, smell, taste, touch, and other motor sensory stem interactions. Many of these systems, by the way, operate as overlaid functions. The vocal tract, for example, is used for breathing, and the ingestion of food. The buccal cavity is used to articulate sounds as well as for the mastication of food. Only two of the sensory inputs into a collective neural linguistic system are addressed: the auditory and the visual system.

6. The Exogenesis of Culture

When Lipton (2006, 2015) argued for epigenetics, he incidentally made a strong case for the exogenesis of culture. He began this journey by explaining how the human brain absorbs information on the role that brain waves play at various stages of growth. All of these electroencephalogram waves (EEG) are not functional at birth. The first wave that appears is the Delta wave (4 Hz or less) which is associated with deep sleep. It dominates the life of a child from birth to around ages 1-2. Lipton associates this with a hypnotic state in which one is open to the incorporation of all kinds of information. It is at this time when one uploads a tremendous amount of information from the environment. The Theta wave comes into function when a child is around 2-6 years old. This wave has to do with a period of calm consciousness and imagination. Lipton notes that from the ages of 2-6, children are essentially operating under a state of unconsciousness, a kind of hypnotic trance. Lipton (2006) argues that this makes sense because the next stage of EEG activity, the alpha wave, requires consciousness. One has to have a working database of perceptions before one is able to develop an awareness of the body or integrate one's feelings. Alpha waves (8-13 Hz) have to do with consciousness and Beta waves (13039 Hz) are involved with the greater concentration of consciousness (Table 3). What fascinated Lipton (2015) about this process is that critical thinking in a person emerges after one has already been programmed in life by others. For the first six years, everything that one has learned has been downloaded into one's mind as a program. In addition, what a person has learned, he has learned from others. What he does is what others told him to do. What he believes is what others believe. His life has been dictated by others. His religion is their religion. His favorite foods are theirs. His choice of clothing comes from them. His way of walking, running, and even thinking is not his own, but theirs. Lipton notes that 95 percent of one's behavior is subconscious. It exists as neural programs that came from an external environment (language, culture, and society) or from an internal culture (nutrition, medication, food, and water). He notes that only 5% of the human brain is involved with creative thinking. The rest of the brain is subconscious (Table 4). It runs programs that are initiated by its environment. The subconscious mind is amazing. When one opens up a newspaper, both pages are automatically processed by the subconscious mind. This is why people are able to do speed reading. The conscious mind, located in the neocortex of the frontal lobes, is highly creative, but it lacks the same processing power.

Table 3. Brain Wave Functions

Brain Waves, Frequencies and Functions			
Unconscious		**Conscious**	
Delta	**Theta**	**Alpha**	**Beta**
Age 1-2	Age 2-6	Age 6 and beyond	Age 12 and beyond
0.5-4 Hz	4-8Hz	8-13 Hz	13-30 Hz
Instinct	Emotion	Consciousness	Thought
Survival, Deep Sleep, Coma	Drives, Feelings, Trance, Dreams	Awareness of the body, Integration of feelings	Perception, Concentration, mental activity

Table 4. Characteristics of Consciousness

Conscious Mind	Creative	Consciously activated	It is not time-bound. It addresses the future, present, and the past	5% of brain Processing capacity 40 bytes
Subconscious Mind	Not creative. Functions as a recording machine	Unconsciously activated	It is time bound It functions only in the present	95% of brain Processing capacity 40,000 bytes

Lipton noted that thinking about changing one's patterns in life does not work. While one is thinking, the creative mind is at work and one is conscious of those ideas. However, this has no effect on the subconscious mind which continues to function as a separate entity (Lipton, 2016). There are techniques to transform the habits of the subconscious mind and Lipton (2016) discusses 7 techniques for doing this. It involves using both hemispheres of the brain while performing tasks. In the popular media it is referred to a Acupuncture Yoga. Nevertheless, this study into EEG activity during growth explains how cultural knowledge is acquired from others unconsciously. Since the stimulus for such behavior comes from the environment, one can only change that behavior by participating in a new cultural environment.

7. The Implications of Mirror Neurons for Communication Theory

Several decades ago, a group of neuroscientists in Palermo, Italy, came across a revolutionary discovery while working with the visual cortex of primates. They noted that when a monkey saw another primate pick up a cup in the laboratory, it would signal these actions neurologically as if it were performing the same gesture (di Pellegrino, Fadiga, Fogassi, Gallese & Rizzolatti, 1992). They knew that intersubjectivity was taking place but they did not know why. Upon closer examination, they learned that the area of the neocortex in the occipital region of the brain of this monkey contained unique neurons. Because it mirrored the actions of others, they called it mirror neurons. Upon further study, it was determined that such neurons also occur within the human brain and it is somehow related to the imitation of the actions of others and to the understanding of their minds (Rizzolatti & Craighero, 2004). What is significant about this research in neuroscience is that it relates to a part of the brain that connects perception with intention. This was revealed when researchers noted that not all behaviors are imitated but only those that associated with well-formed intentional behaviors. When the motor function in another person is intentional and when that motor function is also related to the habitual motor behavior of the observer, then the mirror neurons will be activated. They reasoned that the mind of the observer created a map of the intention of the observed in his own mind. Hence, there is a strong link in the mind between observing the actions of others and recognizing the intent of those actions.

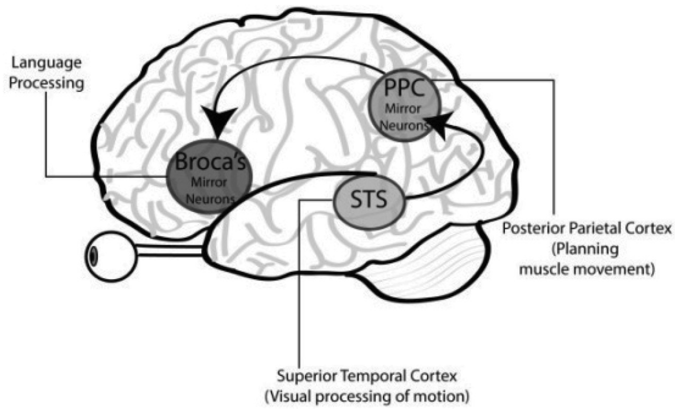


Figure 18. The Mirror Neuron System

Michael Arbib (2006) sees this relationship between observation and intention as a significant factor in how human beings acquired both sign language and other linguistic systems. It is hypothesized that human language began through the use of mirror neurons that connected the observed actions of people who are observed with their intentions. The basis for imitation learning is inherent in the mirror neuron system. Unfortunately, Arbib argues, the mirror neuron system cannot account for the acquisition of syntax because the defining property of human languages is that they use hierarchical recursive structures and these factors are not accessible to sensory motor detection. However, such a claim can be easily challenged by language educators who have been teaching language acquisition by means of sensory motor exercises known as total physical response or TPR (Cantoni, 1998). It is now time to consider how the mirror neuron system is connected to the motor cortex system. This connection is neurologically based on the fact that after visual images are processed by the visual cortex for color, shape, movement, and size, this information is sent to the mirror neuron system and subsequently to the motor neuron system of the brain.

The motor cortex system is the part of the brain that is involved in the planning and the execution of movement within the body. It is divided into three areas. The first is the motor cortex which is involved in sending signals down the spinal column which terminates with the execution of body movement. The second is the premotor cortex which is involved in the preparation of movement or in the spatial guidance of motor control. The third is the supplemental motor area (SMA) and is involved in several functions such as the coordination of actions on both sides of the body, and the planning of sequences of body movement (Ebner, 2005).

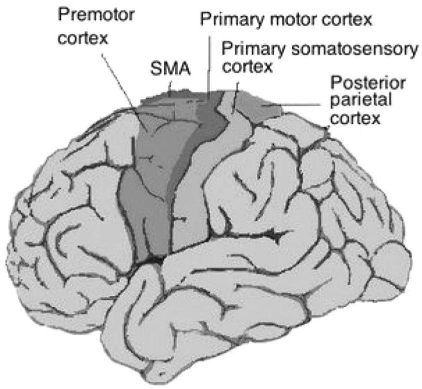


Figure 19. The Motor Cortex System

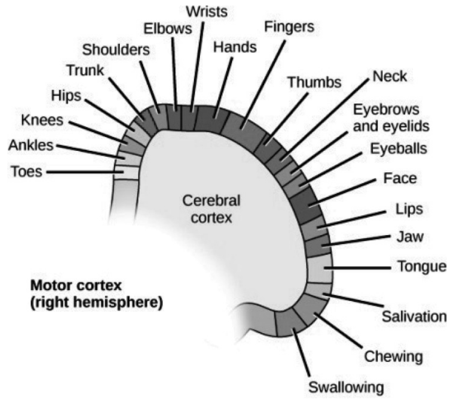
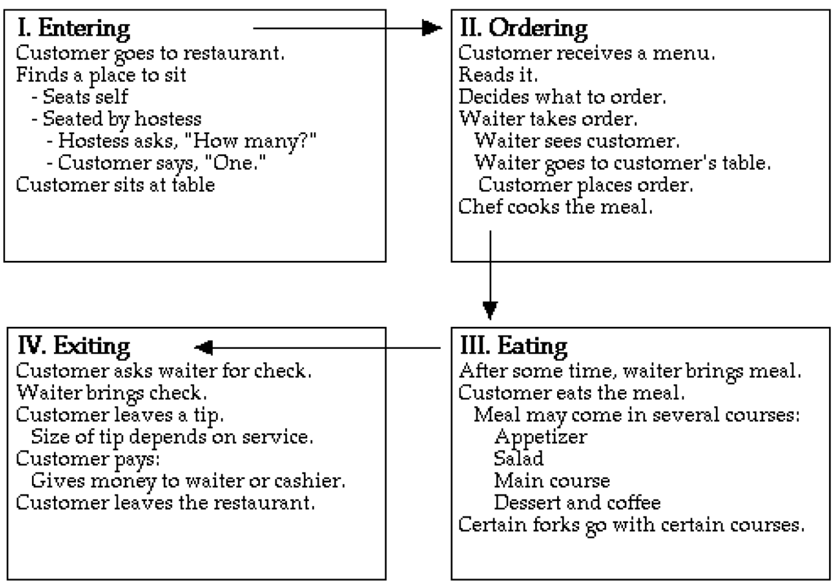


Figure 20. Functions of the Motor Cortex

The motor cortex system has to do with the execution of physical movement over a wide range of parts of the human body. All physical movements are planned and executed by means of this motor system. It is also involved in orchestrated sequences of movements. This is important because human beings learn to imitate others by means of mirror neurons. Consequently, nearly all cultural scripts are acquired in this way. Consider, for example, the cultural script of dining at a restaurant. There is a long sequence of actions that are associated with this cultural scene (St. Clair, 2006).



—Adapted from R.C. Shank and R.P Abelson, *Scripts, Plans, Goals, and Understanding.* Erlbaum, 1977.

Figure 21. Cultural Script for Restaurant Dinning

There are many social scripts that human beings perform and they are subconscious. One that Lipton (2016) mentions is that of driving a car for many miles while doing other tasks in the car and not being aware of performing such complex motor functions and intricate levels of perception until the car was parked. How is this possible? The subconscious brain operates on neural programs. Once a task is learned and repeated for a time, it becomes integrated into the subconscious mind and highly complex sensory motor tasks are performed automatically by the human brain. It was not the conscious mind that drove the car, but the subconscious one.

8. Lexicon-based Semantics

The lexicon plays an interesting role in linguistics. Everyone knows that it is a component of language but they disagree as to where it belongs. Chomsky (1965) inserted the lexicon to phrase structure rules after his language acquisition device had already generated phrase structure rules. This is not where it should be located. The lexicon has to do with meaning. Therefore, it appears that it should be located within the semantic component of language. The study hypothesizes that meaning begins with the lexicon. When children acquire language, they acquire words. The first words that they learn are verbs and these are integrated into the sensory motor system of the brain. Later they acquire nouns and combinations of nouns. These elements of language are structured.

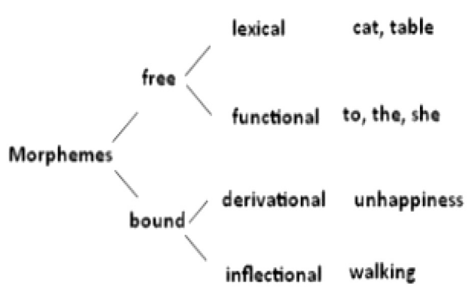


Figure 22. Classification of Morphology

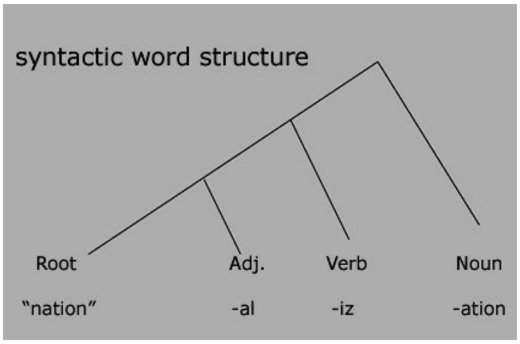


Figure 23. Structural Transforms in the Lexicon

They contain numerous syntactic structures characteristically associated with phrase structure rules. Hence, the precursor to syntax already exists within the lexicon and not within a language acquisition device. Nouns can be transformed into adjectives; adjectives can be converted into verbs; and verbs can be nominalized. Even common polysyllabic words provide evidence of syntactic organization commonly associated with phrase structure rules.

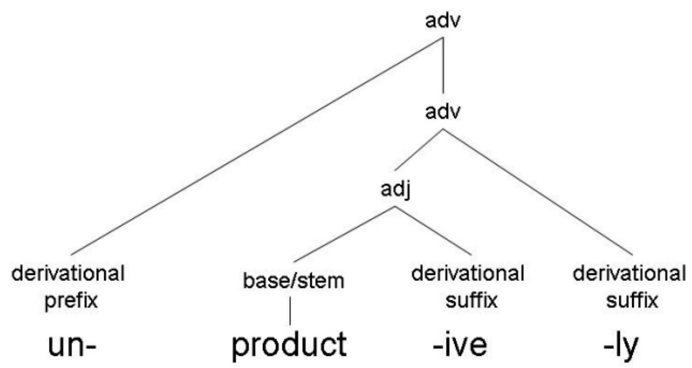


Figure 24. Phrase Structure Analysis of Adverb

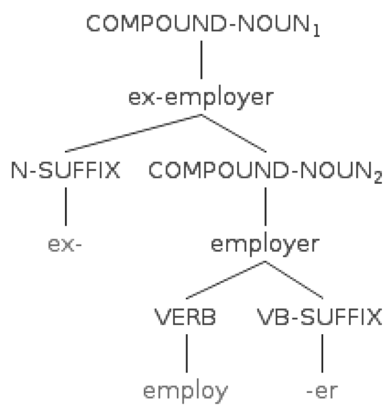


Figure 25. Phrase Structural Analysis of Compound Noun

As a matter of fact, syntactic tree structures are commonly found in compound nouns.

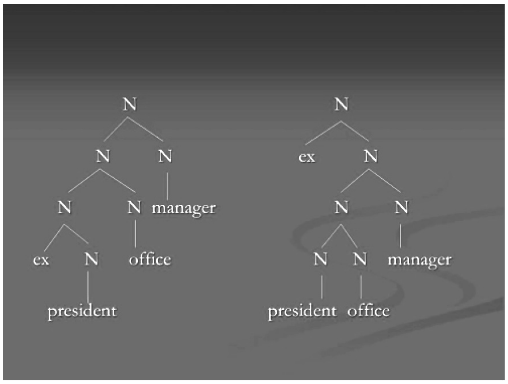


Figure 26. Compound Noun Structure

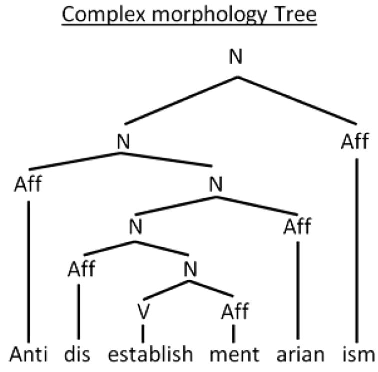


Figure 27. Morphological Phrase Structure

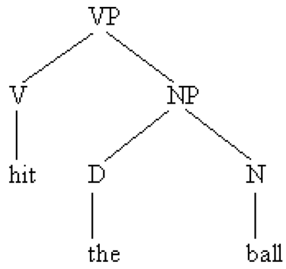


Figure 28. VP Morphology

Even verb phrases (VP) can be ascertained from the morphology of the lexicon. A transitive verb implies that it is syntactically connected to a noun phrase or a sentential clause. Hence, most of the phrasal elements that are generated by syntax already exist within the morphology of the lexicon. What does this information demonstrate? It argues that language begins with words that are acquired from others who are in the human environment and that these words are already syntactically structured. Hence, language is not only exogenetic; it is not generated within the human brain by means of one language acquisition device as proposed by Chomsky (1965). These components, it should be noted, could be readily combined to form the basic sentence structures associated with language.

Table 5. Predicate Nominative

Predicate Nominative Construction		
NP	Copula Verb	NP
John	is	a student

Table 6. Predicate Adjective

Predicate Adjective Construction		
NP	Copula Verb	Adj
The student	is	happy

Table 7. Intransitive Verb

Intransitive Verb Construction	
NP	Intransitive Verb
The man	is running

Table 8. Transitive Verb

Transitive Verb Construction		
NP	VP	
	Transitive Verb	NP / Complement
The boy	hit	the ball
John	wanted	to hear the music

It should be noted that one could move from a phonological form (PF) to some kind of deep structure (D-Structure) where the logical forms of language (LF) could be semantically represented and interpreted. This is where the hypothesis becomes rather complicated. Many of the recurrent problems that motivate current linguistic research would have to be readdressed within this exogenetic model of language. Even if the interconnections between the cranial nerves were biologically mapped out, certain theoretical issues would need to be addressed. From this perspective, the mathematical model provided by Chomsky is not premature. It raises theoretical issues for both exogenetic and endogenetic models of language. How, for example, would the lexicon-based model of semantics account for the syntactic and the semantic treatment of unaccusative and unergative verbs? How would logical forms be ascertained within this lexicon-based model? When Chomsky began his model with syntax and added then envisioned both the phonological and the semantic components as interpretive, he was challenged for this assertion. However, even with an exogenetic model of language, one needs to interpret the PF and LF structures within a universal grammar (UG).

9. Concluding Remarks

Much has been inferred about the biological nature of cognitive linguistics and one could argue that it is no more than a mathematical model that merely infers the biological nature of language. It never really uses either biology or physiology in its argumentation. This assertion has some merit. The current model begins with these natural science disciplines and makes an argument that language is ontogenetic. It also challenges the traditional model of communication for not specifying these aspects of its interdisciplinary research. It accomplishes this by incorporating current research on epigenetics from biology and mirror neurons from neuroscience. It also argues that traditional communication models need to employ these discoveries in their models. Hence, there is a biological focus introduced in this research that is not fully dealt with in communication theory. As for the study of language, the mathematical foundations of that discipline have been resituated within a biological model of language. Language processing, in this model begins with semantics rather than syntax. It is argued that there are many kinds of phrase structural forms already incorporated within the lexicon of a language. Hence, the transition towards a syntactic model of language is simplified. Upon closer examination, however, such is not the case. Many of the research questions that are being addressed by current linguistic theory will have to be investigated within a lexicon-based semantics model. The transition from PF to LF in this model is oversimplified. A biological model of language will need to address a host of theoretical issues that currently constitute linguistic investigation. The same needs to be said about communication theory. It cannot be a model of how people use language. This framework is too simplistic. Even if one developed an exogenetic model of communication as presented in this exploratory investigation, one needs a deeper theory of communication.

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