

# **The Extended Mind Model of the Origin of Language and Culture**

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A model based on the evolution of notated language and chaotics is presented to explain the emergence of language. Language emerges as the bifurcation from percept-based to concept-based thought. Our first words are our first concepts and act as strange attractors for the percepts associated with that concept. The mind is shown to be the brain acting as a percept processor plus language.

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## **Introduction**

I believe that the evolution of notated language has lessons that can help us understand the origin and emergence of speech. My first work with notated language began with a study I conducted with Marshall in which we studied the effects of the phonetic alphabet and literacy on the development of deductive logic, abstract science, codified law, and monotheism (McLuhan and Logan 1977; Logan 1986). We showed that these five developments, which emerged between the Tigris-Euphrates Rivers and the Aegean Sea between 2000 and 500 BC, formed an autocatalytic set of ideas that supported each other's development. The alphabet not only served as a convenient way to notate speech it also taught the lessons of analysis (breaking up words into their basic phonemes), coding (writing), decoding (reading) and classification (alphabetization).

From this work emerged the notion that language is both a medium of communication and an informatic tool since the structure of a language influences the way in which people organize information and develop ideas. I then formulated the hypothesis that speech, writing, math, science, computing and the Internet represented six independent languages each with its own unique semantics and syntax (Logan 1995, 2000a). I further showed that these six forms of language formed an evolutionary chain of languages with each new language emerging from the previous forms of language as a bifurcation to a new level of order ala Prigogine in response to an information overload that the previous set of languages could not handle.

Writing and mathematical notation arose in Sumer as a response to keeping track of the tributes farmers paid to the priests in the form of agricultural commodities as documented by Schmandt-Besserat (1978, 1992). This gave rise to formal schools to teach the skills of reading, writing and arithmetic (the 3 R's), which in turn led to scholars and scholarship giving rise to an overload that science (organized knowledge) was able to

deal with. Science gave rise to its information overload, which in turn led to computers and computers gave rise to its information overload, which in turn led to the Internet.

### **The Emergence of Language as the Bifurcation from Percepts to Concepts**

**T**HE results of my previous work gave rise to the question: How did the first language, speech, from which the other languages evolved, arise in the first place? It is from this consideration that I first became interested in the origin of language problem and literature. My earlier work with the evolution of notated language was based on the premise that a new form of language evolved in response to the chaos resulting from the information overload associated with the previous forms of language. In light of this we should anticipate that the origin of speech was also due to a response to chaos and information overload.

As a starting point I assume that before the advent of speech hominid thought processes as inherited from our earliest ancestors were percept-based. Donald (1991: 226) makes a similar assumption about the perceptual basis of mimetic culture, the culture of hominids that existed just before the emergence of verbal language. “The principle of similarity that links mimetic actions and their referents is perceptual, and the basic communicative device is best described as implementable action metaphor (Donald 1998: 61).”

Our earliest human-like ancestors, which we will refer to as hominids, emerged in the savannas of Africa, where they were an easy target for various predators. To defend themselves from this threat as well as to increase their food supply they acquired the new skills of tool making, the control of fire, group foraging, and coordinated hunting. These activities resulted in a more complex form of social organization, which also increased the complexity of their lives. At first, this complexity could be handled through more sophisticated percept-based responses, but at some point the complexity became too great. Percept-based thought alone did not provide sufficient abstraction to deal with the increased complexity of hominid existence. The hominid mind could no longer cope with the richness of its life based solely on its perceptual sensorium. In the information overload and chaos that ensued, I believe, a new abstract level of order emerged in the form of verbal language and conceptual thinking.

This idea can be expressed in a slightly different way by making use of Ashby's Law of Requisite Variety (LRV) which has been formulated in a number of different ways. I have chosen two that, in my opinion, are more appropriate for understanding language as a system that we use to represent the environment in which we live. One formulation of Ashby's LRV is “a model system or controller can only model or control something to the extent that it has sufficient internal variety to represent it (Heylighen and Joslyn 2001).” Another formulation of Ashby's LRV is “for appropriate regulation the variety in the regulator must be equal to or greater than the variety in the system being regulated (ibid.).” By making use of these formulations of Ashby's LRV we are assuming that language is used by humans to regulate or control their social and physical environment.

I believe that when the complexity of hominid life became so great that perception and learned reactions to perceptions alone could not provide enough requisite variety to model or regulate the challenges of day to day life a new level of order emerged based on concepts. Percepts are the direct impressions of the external world that we apprehend with our senses. Concepts, on the other hand, are abstract ideas that result from the generalization of particular examples. Concepts allow one to deal with things that are remote in both the space and time dimension. If our first words were concepts then language allowed us to represent things that are remote in both space and time and, hence, provide language with what Hockett (1960) defines as displacement.

Concepts also increase the variety with which the brain can model the external world. Percepts are specialized, concrete and tied to a single concrete event but concepts are abstract and generative. They can be applied to many different situations or events. They can be combined with other concepts and percepts to increase variety in ways that percepts cannot.

What, we may ask, was the mechanism that allowed this transition to take place? Assuming that language is both a form of communication and an information processing system I came to the conclusion that the emergence of speech represented the actual transition from percept-based thought to concept-based thought. The spoken word, as we shall see, is the actual medium or mechanism by which concepts are expressed or represented. We must be very careful at this juncture to make sure that we do not formulate the relationship of spoken language and conceptual thought as a linear causal one. Language did not give rise to concepts nor did concepts give rise to language, rather human speech and conceptualization emerged at exactly the same point in time creating the conditions for their mutual emergence. Language and conceptual thought are autocatalytic and the dynamically linked parts of a dynamic cognitive system, namely, the human mind.

Autocatalysis is the mechanism that Kauffman (1995: 49) used to explain the emergence of life: “A living organism is a system of chemicals that has the capacity to catalyze its own reproduction.” An autocatalytic set of chemicals is a group of organic molecules where the catalyst for the production (or really re-production) of each member of the set is contained within the set itself and as a result the system can become a “self-maintaining and self-reproducing metabolism”, i.e. a living organism, in the presence of a source of energy and the basic atoms needed to build organic compounds. A key idea in Kauffman's approach is that the members of the autocatalytic set self-organize and, hence, bootstrap themselves into existence as a set with an identity different from the individual members that make up the set.

An autocatalytic process is one that catalyzes itself into a positive feedback loop so that once the process starts, even as a fluctuation, it begins to accelerate and build so that a new phenomenon emerges. The emergence of language and conceptual thought is an example of an autocatalytic process. A set of words work together to create a structure of meaning and thought. Each word shades the meaning of the next thought and the next words. Words and thoughts are both catalysts and products of thoughts and words.

Language and conceptual thought is an emergent phenomena. It bootstraps itself into existence.

We will make use of a more generalized form of autocatalysis and suggest that any set of mechanism or ideas that catalyze each other's existence is an autocatalytic set—an autocatalytic set of mechanisms or ideas. Language and conceptual thought form an autocatalytic set because language catalyzes conceptual thought and conceptual thought catalyzes language. Just to better define autocatalysis let us return to our discussion of the alphabet effect in which it was postulated that the phonetic alphabet, codified law, monotheism, abstract science and deductive logic are a set of ideas that are self-supporting. One can also say that these ideas or ways of organizing thought form an autocatalytic set of ideas.

### **The Relationship of Percepts and Concepts**

THE use of a word transforms the brain from one state to another and replaces a set of percepts with a concept. A word is a strange attractor for all the percepts associated with the concept represented by that word. A word, therefore, packs a great deal of experience into a single utterance or sign. Millions of percepts of a linguistic community are boiled down by the language to a single word acting as a concept and a strange attractor for all those percepts.

I (Logan 1997) developed the notion that a concept and a word are equivalent when I first presented the Extended Mind model back in 1997. Words represents concepts and concepts are represented by words. It is my belief that they emerged together so that words provided a medium by which concepts could be represented, manipulated, spoken about and thought about. This differs dramatically from the position of many linguists like Steven Pinker (2003) who believe that words emerged for the purpose of the communication of concepts that already existed before language emerged. There is no conflict with my view and Pinker's that words and concepts are connected. He recently suggested that "a word is an arbitrary sign; a connection between a signal and a concept." Where we differ is on the question of which came first the chicken (word) or the egg (the concept). For Pinker first comes the concept and then the word whereas I believe that they co-emerged. I believe that the word gave substance to the concept and the concept was represented by the word. The word is more than a symbol or a sign that represents a thing or a concept. To my way of thinking the word is the concept and the concept is wrapped in a word encased in a phonological utterance. To understand the origin of language and words we have to understand the origin of concepts and why they emerged.

A concept in the form of a word links many percepts of an individual and, hence, extends the brains capacity to remember. Words as concepts are a form of "artificial memory" which create "artificial connections." Words bring order to a chaotic mind filled with the memories of a myriad of experiences. Language is an emergent order.

Concepts are 'artificial or virtual percepts' - instead of bringing the mountain or the percept of the mountain directly to the mind the word brings the mind to the mountain through the concept of the mountain. The concept of the mountain triggers instantaneously all of the mind's direct experiences of mountains as well as instances

where the word “mountain” was used in any discourses in which that mind participated either as a speaker or a listener. The word “mountain” acting as a concept and an attractor not only brings to mind all “mountain” transactions but its also provides a name or a handle for that attractor/concept which makes it easier to access memories and share them with others. They speed up reaction time and, hence, confer a selection advantage for their users. And at the same time those languages and those words within a language which most easily capture memories enjoy a selection advantage over alternative languages and words respectively.

In suggesting that the first words were the strange attractors of percepts I did not mean to imply that all words arose in this fashion. I certainly believe that the first words to appear were the strange attractors of percepts but once a simple lexicon of words and a primitive grammar came into being a new mental dynamic was established. The human mind was now capable of abstract thought and abstract concepts which would be need to be represented by new words. These new words would not have emerged as attractors of percepts but rather as representations of abstract concepts in the form of grammatical relationships among words. The first words of this nature would have been, in all likelihood, associated with grammar and categorization. Examples of the former would be function words such as: *he, she, this, that, and, or, but, if*, etc. and examples of the words for categorization would be words such as: *animals, people, birds, fish, insects, plants, and fruits*.

In proposing that human language began with the emergence of words acting as concepts I am following a tradition known as the lexical hypothesis which posits that “the lexicon is at the center of the language system (Donald 1991: 250).” Language began with a lexicon, which then gave rise to phonological and syntactical structures. Syntactical structures are also concepts. They are concepts that encompass relationships between words just as words are concepts that encompass relationships between percepts.

### **The Complexity of Hominid Existence**

**W**E are still left with the question, however, what developments in hominid evolution gave rise to the complexity, the information overload, and, hence, the chaos that led to the bifurcation from perception to conception—and the emergence of speech. No single development or breakthrough triggered this event but rather the accumulation of developments that included the use of tools, the control of fire, the larger social settings fire engendered, the social organization required for large group living, food sharing, group foraging and co-ordinated large scale hunting that resulted from the larger living groups and the emergence of non-verbal mimetic communication as has been described by Merlin Donald (1991) in *The Making of the Modern Mind*.

Deacon (1997) cites a similar set of hominid developments associated with the advent of speech. They include the provision of meat through hunting or scavenging, the use of stone tools for hunting and butchery, and social institutions or organization such as marriage and ritual. Christiansen (1994) and his co-workers (M. Christiansen & J. Devlin 1997, M. Christiansen, R. Dale, M. Ellefson & C. Conway In press; M. Christiansen & M. Ellefson 2002) cite another set of skills associated with the advent of speech, namely, sequential learning and processing. But since tool making and use, social organization and

mimetic communication all involve sequential learning and processing the hypotheses of Donald, Deacon and Christiansen are similar. The aspects of hominid life that they allude to create new levels of complexity and result in new skill sets which they believe served as pre-adaptations of language. In my model language arises from this complexity while for Donald, Deacon and Christiansen the new skill sets act as pre-adaptations for language. There is nothing contradictory about my approach and theirs. In fact, they reinforce each other. Both the skill sets acting as pre-adaptations and the bifurcation to a new level of order due to the increase to complexity complement each other and each in their own way contributed to the emergence of language.

One thing is clear, however, percepts no longer had the richness or the variety with which to represent and model hominid experience once the new skills of hominids were acquired. It was in this climate that speech emerged and the transition or bifurcation from perceptual thinking to conceptual thinking occurred. The initial concepts were, in fact, the very first words of spoken language. Each word served as a metaphor and strange attractor uniting all of the pre-existing percepts associated with that word in terms of a single word and, hence, a single concept. All of one's experiences and perceptions of water, the water we drink, bathe with, cook with, swim in, that falls as rain, that melts from snow, were all captured with a single word, water, which also represents the simple concept of water.

In my model I assume that the human brain interacting with its environment, its memories of its past experiences in the form of percepts, its intention to communicate and its social community is a non-linear dynamic system. A word operating as a concept acts as an attractor for all of the percepts associated with that word. An attractor is a trajectory in phase space towards which all of the trajectories of a non-linear dynamic system are attracted. The meaning of the word being uttered does not belong simply to the individual but to the community to which that individual belongs.

Furthermore the meaning of the word at any given instance emerges from the context in which it is being used. The attractor is a strange attractor because the meaning of a word never exactly repeats itself. The trajectories of a strange attractor never meet even though they come infinitesimally close to each other. It is the same with a word. The meaning of a word fluctuates about the strange attractor but it is never exactly the same because the context in which the word is being used is always different. The context includes the other words in the utterance, who made the utterance, the social context in which the utterance was made, and the medium in which the utterance was made. Given that the medium is the message as was explained above the meaning of the word will be subtly effected according to whether the word was spoken, whispered, written, telephoned, telegraphed, emailed, or appeared on a Web site.

Our use of the word utterance in the above paragraph is an example of how context shifts meaning. Utterance usually refers to the oral production of language but in the context we just used it took on the meaning of the general construction of a sentence independent of the medium used to express it. Although in most cases a word moves around an attractor in the phase space of meaning from time to time a word can bifurcate into two meanings. An example of this is the appropriation of the words hot and cool to

refer to two different styles of jazz, namely, dixieland and bebop respectively. The word cool used in jazz further bifurcated to add the meaning avante garde, “with it”, or hip. Hip is another example of a word that bifurcated.

The fact that we chose to identify words as strange attractors reflects the fact that words in the contexts of an utterance have multiple even ambiguous meanings or multiple simultaneous perspectives to use the language of Tomasello (1999: 8-9). Within the context of spoken language the ambiguity is reduced because the prosody and accompanying gestures and hand movements add additional meanings to the words being spoken. Within the context of written language without these extra-verbal signals the ambiguity of a word is at its greatest. Within the context of mathematics and science in which terminology is given precise definitions the ambiguity of words is at a minimum. The attractors that represent mathematical and scientific terms approach fixed point attractors but are not totally fixed point attractors. There is always a bit of fuzziness about even mathematical and scientific terms which can be attributed to the differences of opinions of mathematicians and scientists, on the one hand, and to Gödel's Theorem in the realm of math and the Heisenberg uncertainty principle in the realm of quantum physics, on the other hand.

Spoken language and abstract conceptual thinking emerged at exactly the same time as the bifurcation from the concrete percept-based thinking of pre-lingual hominids to conceptual-based spoken language and thinking. This transition, an example of punctuated equilibrium, I believe, was the defining moment for the emergence of the fully human species *Homo sapiens sapiens*. This discontinuous transition illustrates Prigogine's theory of far from equilibrium processes and the notion that a new level of order can suddenly emerge as a bifurcation from a chaotic non-linear dynamic system (Prigogine and Stengers 1984; Prigogine 1997).

Dunbar (1998) has also made a link between the advent of language and the complexity of hominid existence, as measured by the size of the social group. He suggested that language replaced grooming as a way of creating social cohesion as the size and complexity of the social group increased. “The principle function of language was (and is!) to enable the exchange of social information ('gossip') in order to facilitate bonding in larger, more dispersed social groups (ibid.: 98).”

### **Three Preverbal Forms of Proto-language: Tool making, Social Intelligence and Mimesis**

**T**HE transition from percept-based thinking to concept-based thinking represented a major discontinuity in human thought. During this period, hominids developed the set of survival skills associated with tool making and use, the control of fire, cooperative social structures and organization, large scale coordinated hunting, and mimetic communication (Donald, 1991). Based on the work of Merlin Donald I would interpret these major breakthroughs in hominid cognition as the emergence of three distinct percept-based preverbal proto-languages:

1. manual praxic articulation (or tool making and use),
2. social organization or the language of social interaction (which is sometimes characterized as social or emotional intelligence),
3. preverbal communication which entails the use of hand signals, mime, gesture and prosodic vocalization which Donald (1991) defines as mimetic communication.

Before proceeding with my analysis I have to comment on my use of the term protolanguage which Derek Bickerton (1990) coined to describe a stage in the development of human language in which a lexicon of a small number of words existed without syntax and utterances were confined to less than five words. I actually quite independently used the term proto-language with a hyphen before becoming acquainted with Bickerton's work in a 1997 paper (Logan 1997) to describe what I am now referring to as the "three percept-based preverbal proto-languages" listed above.

I believe that these three forms of preverbal activities identified by Donald as elements of mimetic culture are actually proto-languages although he never spoke of them in these terms. As Bickerton has already co-opted the term protolanguage to describe the first stage of verbal language I have altered my use of the term proto-language and will describe toolmaking, social organization and mimetic communication as three forms of "percept-based preverbal proto-language." In a certain sense I regard these three form of preverbal proto-language as more proto than Bickerton's protolanguage because they are earlier. To sum up I see an evolution from preverbal proto-language as identified by Donald to verbal Bickertonian protolanguage to full verbal language as the following time sequence indicates:

1. toolmaking,
  2. social intelligence,
  3. mimetic communication (hand signal, gesture, body language and vocalization),
  4. protolanguage (a limited verbal lexicon without syntax as defined by Bickerton),
- and
5. full verbal language (with a lexicon and syntax).

The reason that I suggest that the first three breakthroughs in hominid cognitive development can be understood as three percept-based preverbal proto-languages is that they each represented a primitive form of communication and information processing, the two basic functions that I have used to define a language. Mimesis according to Donald (1998: 61) "establishes the fundamentals of intentional expression in hominids, without which language would not have had an opportunity to evolve such a sophisticated, high-speed communication system as modern language unless there was already a simpler slower one in place."

The three preverbal proto-languages listed above were, according to Donald, the cognitive laboratory in which the skills of generativity, representation and communication developed and, hence, were the source of the cognitive framework for speech. They also entail sequential learning and processing and, hence, following the ideas of Christiansen (1994) could have served as pre-adaptations for speech.

Justification for regarding the mimetic skill set Donald identifies as preverbal proto-languages is that each one possesses its own unique primitive form of semantics and syntax, protosemantics and protosyntax, if you will. The protosemantics of manual praxis or tool-making and tool-use are the various components that go into making of the tool,

i.e., the materials and the procedures needed to create and use the tool. The tools themselves become protosemantic elements in the preverbal proto-language of tool use. The protosyntax of toolmaking and tool-use is the order or sequence in which the procedures for making and using the tools are carried out. If the correct order or sequence is not adhered to then the task to be completed will not be accomplished.

If, as we have postulated in *The Sixth Language* (Logan 2000a), a new language emerges when there is some form of information overload, then we should be able to identify the chaos or information overload that led to the emergence of the preverbal proto-language of tool-making and tool-use. Perhaps it was the flood of extra information that the earliest hominids had to deal with in order to survive as bipeds in the savanna where the protection of living in the tree tops was no longer available. Tools were created to deal with the new challenges of living at ground level where there were far more dangers than in the tree tops.

The skills associated with toolmaking presumably led to the control of fire and to transporting it from one site to another. The control of fire in turn contributed to new and more complex social structures as nuclear families banded together to form clans to take advantage of the many benefits that fire offered such as warmth, protection from predators, tool sharpening, and cooking, which increased the number of plants that could be made edible, killed bacteria and helped to preserve raw foods such as meat. These larger social structures bred a new form of information overload because of the increased complexities of social interactions and organization. In this environment a new preverbal proto-language of social interactions emerged with its protosemantics of social transactions which included greetings, grooming, mating, food sharing, and other forms of co-operation appropriate for clan living. The protosyntax of the social organization or intelligence included the proper ordering or sequencing of these transactions in such a way as to promote social harmony and avoid interpersonal conflict, and, hence, contribute to the survival and development of hominid culture.

The overload of interacting with many people and carrying out more sophisticated activities led to the need for better communications to better co-ordinate social transactions and co-operative activities such as the sharing of fire, the maintenance of the hearth, food sharing, and large scale co-ordinated hunting and foraging. From the chaos of this complexity emerged the preverbal proto-language of mimetic communication.

The protosemantics of mimetic communication, the third preverbal proto-language, consisted of the following elements: the variety of tones of non-verbal vocalization, facial gestures, hand signals and miming actions (or body language). The protosyntax of this form of communication is the sequencing and co-ordination of these elements. Combining a gesture and a vocal tone would have a different meaning than the same tone followed by the gesture after some delay or the gesture followed by the tone. As the syntactical complexity of mimetic communication grew and became more sophisticated it set the stage for the next development in hominid communication, namely, verbal language in the form of speech which vestigially incorporates the elements of mimetic communication. It is not the literal meaning of words alone which convey the message of spoken language but the tone of the words, the way they are inflected, as well as the facial gestures, hand motions and body language which accompany them.

Embedded in the syntax of each of the three preverbal proto-languages of toolmaking, social intelligence and mimetic communication there are generative grammars which allow:

1. different ways of articulating tools and manual praxis to carry out a variety of new tasks as new challenges arise;
2. the creation of new forms of co-ordination and social cohesion to meet the infinite variety of challenges life presents including the navigation through different forms of social conflict, the variety of which is endless;
3. the expression of a large number and shades of meaning and feelings through mimetic communication.

Starting with the manufacture and use of tools hominids began to develop the capability of generativity essential for verbal language. Employing the correct syntax of the preverbal proto-languages, i.e. doing things in the proper order or sequence served as the pre-adaptation for the generative grammar of verbal language. This model supports Chomsky's theory that humans possess a generative grammar that makes the rapid and universal acquisition of speech by young children possible. It also provides an alternative explanation to Chomsky's notion that the generative grammar is somehow magically hard wired into the human brain.

Merlin Donald's (1991) work suggests that the generative grammars for the preverbal proto-languages of toolmaking (or manual articulation), social organization (or social intelligence) and mimetic communications served as a pre-adaptation for the generative grammar of spoken language.

Mimetic skill represented a new level of cultural development, because it led to a variety of important new social structures, including a collectively held model of the society itself. It provided a new vehicle for social control and coordination, as well as the cognitive underpinnings of pedagogical skill and cultural innovation. In the brain of the individual, mimesis was partly the product of a new system of self-representation and mostly the product of a supramodular mimetic controller in which self-action may be employed to 'model' perceptual event representations. Many of the cognitive features usually identified exclusively with language were already present in mimesis: for instance, intentional communication, recursion, and differentiation of reference. (ibid.: 199-200)

My model for the emergence of language is based on Donald's work with the added twist that I believe that speech is concept-based and emerged as a bifurcation from the percept-based preverbal proto-languages we have just identified. My model for the origin of verbal language which I have just outlined was developed in 1997 and, for the most part, grew out of my previous work (1995, 2000) with the evolution of notated language plus my reading of Merlin Donald's *Making of the Modern Mind*. I have since then become acquainted with Deacon's (1997) *The Symbolic Species* in which he also suggests an association of the emergence of speech with toolmaking:

The appearance of the first stone tools nearly 2.5 million years ago almost certainly correlates with a radical shift in foraging behavior in order to gain

access to meat. And this clearly marks the beginnings of the shift in selection pressures associated with changes in the brain relevant for symbolic communication. (ibid.: 386)

While Deacon does not make use of the concept of social organization or intelligence he does introduce the notion that changes in the social dynamics of hominids led directly to symbolic communication and that marriage itself was one of the first forms of symbolic communication in which the parties to the marriage were themselves symbols.

The near synchrony in human prehistory of the first increase in brain size, the first appearance of stone tools for hunting and butchery, and a considerable reduction in sexual dimorphism is not a coincidence. These changes are interdependent. All are symptoms of a fundamental restructuring of hominid adaptation, which resulted in a significant change in feeding ecology, a radical change in social structure, and an unprecedented, (indeed, revolutionary) change in representational abilities. The very first symbol ever thought, or acted out, or uttered on the face of the earth grew out of this socio-economic dilemma, and so they might not have been very much like speech....Marriage is not the same as mating, and not the same as a pair bond. Unlike what is found in the animal world, it is a symbolic relationship....Symbolic culture was a response to a reproductive problem that only symbols could solve: the imperative of representing a social contract....The symbol construction that occurs in these ceremonies is not just a matter of demonstrating certain symbolic relationships, but actually involves the use of the individuals and actions as symbol tokens. (ibid.: 400-1, 406)

While Donald speaks of speech emerging from mimetic communication Deacon in a slightly different tack sees speech as assimilating these features and co-evolving with them.

With the final achievement of fully articulate speech, possibly as recently as the appearance of anatomically modern *Homo sapiens* just 100,000 to 200,000 years ago, many early adaptations that once were essential to successful vocal communication would have lost their urgency. Vestiges of these once-critical supports likely now constitute the many near-universal gestural and prosodic companions to normal conversation. (ibid.: 364)

As to determining whether Deacon or Donald provide the most accurate model of the relationship between toolmaking, social organization and mimetic communication and speech there is no scientific criteria for making a choice. It is difficult if not impossible to falsify their propositions because data from the events they describe is so scarce. We must resort to the Kuhnian (1972) notion that the choice of rival descriptions will have to be based on what the reader finds most compelling.

## **The Origin and Evolution of the Extended Mind**

I have attempted to develop insights into the role that language has played in the development of human thought and culture by combining ideas on the nature and function of language, the concept of bifurcation from chaos theory and Merlin Donald's (1991) notions of evolutionary psychology. Building on these ideas I would like to tackle the age old question of the relationship of the human mind and the brain. For some psychologists this is a non-problem as they believe that the brain and the mind are synonymous, just two different words to describe the same phenomena, one derived from biology, the other from philosophy. For others there is a difference. Some define the mind as the seat of consciousness, thought, feeling and will. Those processes of which we are not conscious, such as the regulation of our vital organs, the reception of sense data, reflex actions, and motor control, on the other hand, are not activities of our mind but functions of our brain.

I believe that there is no objective way to resolve these two different points of view but that a useful distinction can be made between the mind and the brain based on our dynamic systems model of language as the bifurcation from concrete percept-based thought to abstract concept-based thought. I, therefore, assume that the mind came into being with the advent of verbal language and, hence, conceptual thought. This transition did not occur with the first emergence of words in the form of Bickertonian protolanguage which contained a modest lexicon but no syntax. I believe this transition to the human mind took place with the emergence of syntax approximately 50 to 100 thousand years ago, which allowed for full generativity and the ability of language to represent all aspects of the world.

Syntactilized verbal language extended the effectiveness of the human brain and created the mind. Language is a tool and all tools, according to McLuhan (1964), are extensions of the body that allow us to use our bodies more efficiently. I believe, that language is a tool which extended the brain and made it more effective thus creating the human mind which I have termed the extended mind. I have expressed this idea in terms of the equation: mind = brain + language.

It was the following passage from McLuhan's (1964) book *Understanding Media* that inspired this hypothesis:

It is the extension of man in speech that enables the intellect to detach itself from the vastly wider reality. Without language, Bergson suggests, human intelligence would have remained totally involved in the objects of its attention. Language does for intelligence what the wheel does for the feet and the body. It enables them to move from thing to thing with the greatest ease and speed and ever less involvement. Language extends and amplifies man but it also divides his faculties. His collective consciousness or intuitive awareness is diminished by this technical extension of consciousness that is speech.

The human mind is the verbal extension of the brain, a bifurcation of the brain which vestigially retains the perceptual features of the hominid brain while at the same time becoming capable of abstract conceptual thought. Bickerton (1995: 150) reaches a similar conclusion and makes a distinction between a “brain-state” and a “mind-state.”

The emergence of syntactilized language also represents, for me, the final bifurcation of hominids from the archaic form of *Homo sapiens* into the full fledged human species, *Homo sapiens sapiens*. Crow (2002: 93) reaches a similar conclusion. He points out that pictorial art demonstrating a capacity for representation, an essential element of human language can only be traced back to around 90,000 years ago and was absent for both Neanderthal and *Homo Erectus*. Citing Stringer and McKie (1996), he concludes, “The parsimonious conclusion (because it links the distinctive characteristic of the species to its genetic origin) is that the origin of language coincided with the transition to modern *Homo sapiens* dated to somewhere between 100,00 and 150,000 years ago.”

Humans are the only species to have developed verbal language and also to have experienced mind. This is not to deny that our ancestors, the earlier forms of hominids, experienced thought and consciousness. Their thought patterns, however, were largely percept-based and their brains functioned as percept processing engines operating without the benefit of the abstract concepts which only words can create and language can process. It follows that animals have brains but no minds and that the gap between humans and animals is that only humans possesses verbal language and mind.

In summary, the emergence of language represents three bifurcations:

1. the bifurcation from percepts to concepts,
2. the bifurcation from brain to mind, and
3. the bifurcation from archaic *Homo sapiens* to full fledged human beings, *Homo sapiens sapiens*.

These three bifurcations are not necessarily simultaneous. Bickerton claims (1990, 1995) that protolanguage in which the first words were used symbolically emerged with *Homo erectus* which means the first bifurcation can be dated to approximately 2 million years ago. The second and third transitions, on the other hand, can be dated to the emergence of fully syntactilized language which occurred only 100 to 150 thousand years ago and seems to be correlated with the explosion of human culture and technological progress of that time period (Bickerton 1995: 65).

This hypothesis or model provides a possible explanation of the fate of Neanderthals who had a slightly larger brain than *Homo sapiens sapiens* but who, it seems, did not use spoken language. This conclusion, disputed by some, is based on the analysis of fossil remains which reveal that Neanderthal's vocal tracts were not as well developed as those of humans. Neanderthals who survived for over a hundred thousand years were dominated by their human rivals and disappeared in Europe after only 10,000 years of living side by side with humans. Obviously the mind, which combines the features of both the percept engine which is the brain and the concept generator of verbal language is a more powerful instrument of reasoning and thought than the brain alone. Once language emerged the size of the brain alone was no longer the sole determining factor in intelligence as had been the case for the evolution of the hominid brain.

Empirical data suggests that the size of the brain alone without language is not a particularly smarter brain. Bickerton (2000: 271) points out that,

when the brain doubled in size, hominids did not get twice as smart. Artifact production and behavioural changes from *Homo habilis* to Neanderthal are insignificant compared to those found once our own species emerged, and unless there is no relationship whatsoever between intelligence and the products of intelligence (including tools and behaviour), an enlarged brain did not, in and of itself, significantly enhance the former.

What did enhance the former, in my opinion, was language.

Deacon has developed an alternative scenario to explain the demise of Neanderthal. He claims they perished as a result of a disease that the *Homo sapiens* arriving from Africa brought with them for which Neanderthals had no resistance in much the same way Amerinds perished from small pox carried to North America by Europeans. While this is certainly a possibility, history has shown that even during the most virulent pandemics a certain percentage of the population always survived. In humans there are roughly 30 genes known as human leukocyte antigens which vary wildly among people and allow a uniform population to survive a plague or an epidemic.

As the brain of hominids increased in size and complexity certain biological limits were reached. The head of an infant could only become so big and pass through the hips of a woman if humans were also to retain their capacity for mobility, an important factor for survival. One evolutionary strategy for packing more reasoning power into the small space of the head was the development of convolutions of the brain; another was the gender differentiation of the male and female anatomy and the specialization of gender tasks. The females had broader hips for childbearing large headed babies and tended to spend more time attending to the tasks associated with the hearth while the males remained narrow hipped and roamed about as the hunters and defenders of the family from marauders.

Another reason for limits on the size of the brain comes from energy considerations.

Brains are extraordinarily expensive organs to evolve and maintain. The average brain weighs about 2% of adult body weight, yet consumes something approaching 20% of the body's total energy intake....Since brains do not come for free, some very powerful selection pressure is required to make it worth a species' while evolving them. Given this, having any space at all dedicated to language (or speech!) must add measurably to the costs incurred by the individual, and would be selected against unless countervailing selection pressure made language advantageous. (Dunbar 1998: 93)

According to the Extended Mind model language acting as an extension of the brain allowed human intelligence to increase without an increase in brain size. "Language (whatever the value of its emergent properties) was not itself the driving force behind the evolution of the superlarge human brain. This would explain why the key language areas

(Broca's, Wernicke's and associated areas) are significantly smaller in volume than those areas associated with social skills and theory-of-mind abilities (the prefrontal cortex) (Dunbar, 1998: 103).” This observation by Dunbar supports our notion that language extends the brain into a mind which operates more efficiently because language accesses associations automatically and triggers memories more efficiently than the brain's neural nets would without the cues from language.

By making use of a facility to create abstract and symbolic thought at the conceptual level the effectiveness of the human mind was able to make a quantum leap forward without making large incremental energy demands. Our claim is that symbolic conceptual thinking is more efficient than concrete perceptual thinking and, hence, there was a selection pressure in favor of the emergence of language. Language extended the brain into a mind capable of symbolic thought. Dunbar concurs with our suggestion that the emergence of speech and the human race were concurrent: “The evolution of language seems to correspond in time to the emergence of our own species, *Homo sapiens* (ibid.: 104).” Bickerton (2000: 276) expresses a similar thought, “It may be hypothesized that a larger number of the first type (those pushing at the boundaries of protolanguage) appeared in southern Africa, probably within the last two hundred thousand years, and that it was this chance agglomeration that launched our species.”

After all the physical mechanisms for increasing human intelligence by increasing head size and brain size had been exhausted nature conspired through chaos theory to increase hominid intelligence with a software rather than a hardware stratagem. The software was verbal language from which emerged the human mind and conceptualization. Words encode basic concepts and, hence, allow for the more efficient processing of information and knowledge. Conceptualization allowed for the creation of more words and new metaphors to achieve still higher levels of conceptualization and representation. Concepts and words formed a dynamic systems bootstrap creating the conditions for their mutual and dynamic development. In other words, language and thought formed an autocatalytic system. A possible metaphor for the role language plays in enhancing brain function is the disk doubler or zip drive used to provide a microcomputer (an artificial brain) with a compact way to store and process data and information. Language is the brain's zip drive converting it into an extended mind.

## References

- Bickerton, Derek. 1990. *Language and species*. Chicago and London: University of Chicago Press.
- \_\_\_\_\_. 1995. *Language and human behaviour*. Seattle: University of Washington Press. Also 1996 edition London: University College London Press.
- \_\_\_\_\_. 2000. How protolanguage became language. In Knight, C. Studdert-Kennedy, M. and Hurford, J. (eds.), *The evolutionary emergence of language*. Cambridge: Cambridge University Press: 264-284.
- Christiansen, Morten. 1994. *Infinite languages finite minds: Connectionism, learning and linguistic structure*. Unpublished doctoral dissertation, Centre for Cognitive Studies, University of Edinburgh UK.
- Christiansen, M. & J. Devlin. 1997. Recursive inconsistencies are hard to learn: A connectionist perspective on universal word order correlations. In *Proceedings of the 19th Annual Cognitive Society Conference*: 113-118. Erlbaum.
- Christiansen, M., R. Dale, M. Ellefson & C. Conway. In press. The role of sequential learning in language evolution: computational and experimental studies. In Cangelosi, A. & Parisi, D. (eds.), *Simulating the evolution of language*. London: Springer-Verlag.
- Christiansen, M. & M. Ellefson. 2002. Linguistic adaptation without linguistic constraints: The role of sequential learning in language evolution. In Wray, A. (ed.), *The Transition to language*. Oxford: Oxford University Press.
- Christiansen, Morten and Simon Kirby. 2003. Language evolution: The hardest problem in science? In Christiansen, M. and Kirby, S. (eds.), *Language evolution*. Oxford: Oxford University Press.
- Deacon, T. W. 1997. *The Symbolic Species: The co-evolution of the brain and language*. New York: W. W. Norton & Co.
- Donald, Merlin. 1991. *The Origin of the Modern Mind*. Cambridge, MA.: Harvard University Press.
- \_\_\_\_\_. 1998. Mimesis and the executive suite. In Hurford, J., Studdert-Kennedy, M. Knight C. (eds.), *Approaches to the evolution of language*. Cambridge: Cambridge University Press: 44-67.
- Dunbar, Robin. 1992. Neocortex size as a constraint on group size in primates. *Journal of Human Evolution* 20: 469-93.

Heylighen, F. & C. Joslyn. 2001. The law of requisite variety.  
<http://pespmcl.vub.ac.be/REQVAR.html>.

Hockett, Charles. 1960. The origin of speech. *Scientific American* 203: 88-111.

Kaufmann, Stuart. 1995. *At home in the universe*. Oxford UK: Oxford University Press.

Kuhn, Thomas. 1972. *The structure of scientific revolutions*. Chicago: University of Chicago Press.

Logan, Robert K. 1986. *The alphabet effect*. 1<sup>st</sup> Edition, New York: Wm. Morrow; 2004, 2<sup>nd</sup> edition, Cresskill NJ: Hampton Press.

\_\_\_\_\_ 1995. *The fifth language: learning a living in the computer Age*. Toronto: Stoddart Publishing.

\_\_\_\_\_ 1997. *The extended mind: understanding language and thought in terms of complexity and chaos theory*. Presented at the 7th Annual Conference of The Society for Chaos Theory in Psychology and the Life Sciences at Marquette U., Milwaukee, Wisconsin, Aug. 1, 1997.

\_\_\_\_\_ 2000a. *The sixth language: learning a living in the internet age*. 1<sup>st</sup> Edition, Toronto: Stoddart Publishing, 2004, 2<sup>nd</sup> Edition Caldwell NJ: Blackburn Press.

\_\_\_\_\_ 2000b. *The extended mind: understanding language and thought in terms of complexity and chaos theory*. In Lance Strate (ed.), *2000 Communication and Speech Annual* Vol. 14, published by The New York State Communication Association.

McLuhan, Marshall. 1962. *The Gutenberg galaxy*. Toronto: Univ. of Toronto Press.

\_\_\_\_\_ 1964. *Understanding Media*. New York: McGraw Hill.

McLuhan, Marshall, and R.K. Logan. 1977. Alphabet, mother of invention. *Etcetera*. Vol. 34. [Dec.].

Pinker, Steven. 2003. Language as an adaptation to the cognitive niche. In Christiansen, M. and Kirby S. (eds.), *Language evolution*. Oxford: Oxford University Press.

Prigogine, Ilya. 1997. *The end of certainty*. New York: Free Press.

Prigogine, Ilya and I. Stengers. 1984. *Order out of chaos*. New York: Bantam Books.

Schmandt-Besserat, D. 1978. The earliest precursor of writing. *Scientific American* 238.

\_\_\_\_\_. 1992. *Before Writing: Vol. 1. From counting to cuneiform.*  
Houston: Univ. of Texas Press.

Stringer, C. and R. McKie. 1996. *African exodus: The origins of modern humanity.*  
London: Johnathan Cape.

Tomasello, Michael. 1999. *The cultural origins of human cognition.* Cambridge, MA:  
Harvard University Press.