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The Origin and Evolution of Language and the Propagation of Organization

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Abstract: In this presentation we will study propagating organization. We begin by examining the evolution and origin of language by briefly reviewing the impact of the phonetic alphabet (Logan 2004a), the evolution of notated language (Logan 2004b), the origin of language and culture (Logan 2006, 2007), the role of collaboration in knowledge management (Logan and Stokes 2004), the impact of "new media" (Logan in preparation). We will then connect this work to the propagating organization of all living organisms (Kauffman et al. in press) where we will show that information in biotic systems are the constraints that instruct living organisms how

to operate. We will demonstrate that instructional or biotic information is quite different than the classical notion of information Shannon developed for addressing engineering problems in telecommunications. We also will show that biosemiosis is in some sense equivalent to propagating organization (Kauffman et al. in press). We then conclude our presentation with the speculation that there exist at least seven levels of biosemiosis.

Keywords: propagating-organization, evolution, language, biosemiosis, culture, new-media

1 The Alphabet Effect (Logan 2004a)

Joseph [Needham \(1956, 1979\)](#) claimed that the Chinese contribution to the development of abstract science in the West was significant. He argued that many practical inventions were transferred from China to the West that stimulated European science. His claim led naturally to the question: Why did abstract theoretical science begin in the West and not in China itself?

I explained this paradox by suggesting that monotheism and codified law, two features of Western culture absent in China, led to a notion of universal law, which influenced the development of abstract science in ancient Greece. I first shared this hypothesis with Marshall McLuhan at a lunch in 1974. He agreed with me but pointed out that I had failed to take into account the phonetic alphabet, a feature of Western culture not found in China. The alphabet, McLuhan claimed, had also contributed to the development of Western science. Realizing that our explanations complemented and reinforced each other, we combined them in a paper entitled "Alphabet, Mother of Invention" ([McLuhan and Logan 1977](#)) to develop the following hypothesis:

Western thought patterns are highly abstract, compared with Eastern. There developed in the West, and only in the West, a group of innovations that constitute the basis of Western thought. These include (in addition to the alphabet) codified law, monotheism, abstract theoretical science, formal logic, and indi-

vidualism. All of these innovations, including the alphabet, arose within the very narrow geographic zone between the Tigris-Euphrates river system and the Aegean Sea, and within the very narrow time frame between 2000 B.C. and 500 B.C. We do not consider this to be an accident. While not suggesting a direct causal connection between the alphabet and the other innovations, we would claim, however, that the phonetic alphabet (or phonetic syllabaries) played a particularly dynamic role within this constellation of events and provided the ground or framework for the mutual development of these innovations.

The alphabet is not only a tool for written communication but it also teaches the lessons of abstraction, analysis, coding, decoding and classification. The alphabet is both a communication medium and an informatic tool. The alphabet, monotheism, codified law, abstract science, deductive logic are media that interacted with each other and co-evolved. The alphabet is a medium that propagates an analytic and abstract form of organization that contributed to the science- and logic-based nature of Western civilization (Logan 2004a).

2 The Sixth Language (Logan 2004b)

The Alphabet Effect taught me that phonetic writing acts as both a medium of communication and as an informatic tool. I discovered the same is true of computers and quickly realized that spoken language was not only a medium of communication but also the medium in which we humans framed our abstract thoughts. I came to the conclusion that: language = communications + informatics.

Writing and mathematical notation were a product of the organization of economic information by accountants and civil servants in Sumer. They had to deal with an information overload resulting from keeping track of the tributes from farmers in the form of agricultural commodities needed for redistribution to irrigation workers. Schools emerged to teach the new skills of reading, writing and arithmetic. The teachers became scholars and another information overload ensued. Science as a form of organized knowledge emerged to deal with this information overload. Science in turn led to another overload in terms of industrial science-based technology. This overload was remedied by computing, which gave rise to another information overload that was finally remedied by the Internet.

These notions led me to postulate that speech, writing, mathematics, science, computing and the Internet form an evolutionary chain of six languages. Each language possesses its own unique semantics and syntax. Each new language emerged as a response to the chaos of the information overload that the previous languages could not handle.

3 The Extended Mind: The Origin of Language, the Human Mind and Culture (Logan 2007)

If speech gave rise to the five different forms of notated language listed above the question naturally arises as to how spoken language came into being. I hypothesized that speech emerged as the bifurcation from percepts to concepts. It arose as a response to the chaos associated with an information overload that ensued from the increased complexity in hominid life, which included:

- 1) Tool making and use;
- 2) The control of fire;
- 3) The social intelligence needed to maintain the hearth;
- 4) Food sharing,
- 5) Group foraging and hunting;
- 6) Mimetic communication which incorporates hand signals, gestures, body language and vocalization.

As the complexity of hominid life increased the percept-based brain alone could no longer cope. There emerged as a result concepts in the form of our first spoken words and this in turn led to the human con-

cept-based mind, which was capable of abstract symbolic thought. Speech represented a bifurcation from percepts to concepts. Our first words became concepts acting as strange attractors for the percepts associated with those words. The word water, for example, unites all our percepts of the water we drink, wash with, cook with, rain, melted snow, lakes, and rivers with one concept represented by the word water. Words act as the medium for abstract thought. Abstract thought is as much silent speech as speech is vocalized thought.

Merlin Donald (1991) claimed that mimetic communication was both intentional and representational and was the cognitive lab in which verbal language developed. If mimetic communication was such a good communication system why did the need for verbal language arise? Spoken language made possible the following survival tools:

- 1) conceptualization,
- 2) symbolic, abstract thought and
- 3) planning by allowing for thought about objects and actions that are not in the immediate perceptual field.

Before language the brain was basically a percept processor. With language the brain became capable of conceptualization and hence bifurcated into the human mind. The emergence of verbal language represents three simultaneous 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.

In short: Mind = Brain + Language

4 Collaborate to Compete: Driving Profitability in the Knowledge Economy (Logan and Stokes 2004)

We operate in the knowledge economy but not enough attention has been paid to the management of an organization's knowledge assets. This has given rise to knowledge management, which we define in the following manner:

Knowledge management (KM) is the organizational activity of creating the environment, both attitudinally and technologically, so that knowledge can be accessed, shared and created within an organization in a way that all of the experiences and knowledge within the enterprise can be organized to achieve the enterprise's objectives and reinforce its values.

Unfortunately KM has failed to deliver on its promise. Why hasn't it been more successful? In Collaborate to Compete (Logan and Stokes 2004) it is suggested that not enough attention has been paid to the human side of knowledge management. We suggest that collaboration is the missing link and not enough attention has been paid to this vital element.

We identify the problem in the following terms: The more complex and sophisticated the technology, the more important are the human behavioral issues of attitude, cooperation and motivation, as well as the training, education and learning of all members of the organization.

The "soft" issues are the "hard" problems. To be competitive an organization must strive to become a collaborative organization. There must be trust, shared knowledge, aligned goals, decentralized decision-

making and minimal hierarchical structures.

The Internet is at the same time a model or metaphor for collaboration as well as a medium for the actual implementation of collaboration.

5 Understanding New Media: Extending Marshall McLuhan (Logan in preparation)

I want to develop an understanding of digital "new media" and their impact using the ideas and methodology of Marshall McLuhan. The "new media" are changing our world as well as the older media that McLuhan (1964) studied in *Understanding Media: Extensions of Man*.

In the Sixth language I identified five characteristics of the Internet, which apply with equal validity to the "new media" and explain their success and rapid adoption. The five characteristics are:

1. two-way communication
2. ease of access to and dissemination of information
3. continuous learning
4. alignment and integration, and
5. community.

In addition to these five characteristics I have also identified nine other characteristics of "new media". They are:

6. portability and time flexibility (time shifting), which provide their users with freedom over space and time;
7. convergence of many different media so that they can carry out more than one function at a time as is the case with the camera cell phone that operates as phone but can also take photos and transmit them;
8. interoperability
9. aggregation of content;
10. variety and choice to a much greater extent than the mass media that preceded them;
11. the closing of the gap between (or the convergence of) producers and consumers of media;
12. social collectivity and cooperation;
13. remix culture; and
14. the transition from products to services.

6 Propagating Organization: An Enquiry (Kauffman, Logan, Este, Goebel, Hobill and Shmulevich in press)

Each of the media that I have described in the first five sections of my talk whether they be the spoken word, the written word, mathematical notation, science, computing, the Internet or "new media", they represent the propagation of organization and parallel the propagating organization of living organisms that replicate themselves.

Our project has as its broad aim an understanding of the propagation of organization as exemplified by the vast organization of the coevolving biosphere. Living cells operate as information processing units, receiving information from their environment, propagating that information through complex molecular networks, and using the information stored in its DNA and cell-molecular systems to mount the appropriate responses. We were looking for a new language and new concepts to deal with information in living systems and the propagation of organization in the biosphere. Our study was based on Kauffman's (2000) book *Investigation*.

Kauffman argued that biology cannot be derived from physics and that living organisms are emergent causal agents in their own right. Physics can explain how the heart operates but it could never predict that the organ of the heart would emerge to pump blood throughout the organism.

In our paper we argued that Shannon information does not apply to the evolution of the biosphere because one cannot prestate all possible Darwinian preadaptations or the ensemble of possibilities and hence their entropy cannot be calculated.

According to Shannon a structured set of numbers like the set of even numbers has less information than a set of random numbers because one can predict the sequence of even numbers. By this argument a random soup of organic chemicals has more information than a structured biotic agent. The living organism has more meaning than the soup, however. The living organism, however, with more structure and more organization has less Shannon information. This is counterintuitive to a biologist's understanding of a living organism. We therefore conclude that one cannot use Shannon information to describe a biotic system. Shannon information for a biotic system is simply a category error.

A living organism has meaning simply because it is an autonomous agent acting on its own behalf. A random soup of organic chemicals, on the other hand, has no meaning and no organization. We therefore conclude that the meaning of life is organization - propagating organization.

6.1 The Relativity of Information

We have argued that Shannon information does not properly describe the information of an autonomous agent that propagates its organization. We have identified the constraints in a cell that direct the flow of free energy to do work as instructional or biotic information which is distinct from Shannon information.

The question one might ask isn't information just information, i.e., an invariant like the speed of light. Our response to this question is no, information is relative. Instructional or biotic information describes the information of biotic systems just as Shannon information was useful for telecommunication engineering projects.

Work is the constrained release of energy into a few degrees of freedom. Where do the constraints themselves come from, however. Consider the example of a cylinder and piston that confines the expansion of a working gas in the head of the cylinder so as to drive or move the piston. This represents the release of energy into a few degrees of freedom. However, it typically takes work to construct the constraints. Thus we arrive at the first surprise - it takes constraints on the release of energy for work to happen, but work for the constraints themselves to come into existence. This circle of work and constraint shall turn out to be part of our theory of propagating organization.

Before the discovery of DNA Schrödinger correctly predicted that the order of life had to be coded in an aperiodic solid crystal, which could contain a wide variety of microconstraints, or micro boundary conditions, that help cause a wide variety of different events to happen in the cell or organism.

We therefore identify "instructional" or "biotic" information not with Shannon information, but with constraints or boundary conditions that allows a living organism to act on its own behalf. The amount of information will be related to the diversity of the constraints and the diversity of processes that they can partially cause to occur.

We therefore conclude that the constraints are information and information is constraints, which we term as “instructional” or “biotic” information to distinguish it from Shannon information. We use the term “instructional” information because of its function or “biotic” information because of the domain in which it operates.

6.2 Semiosis

We argue that when an autonomous agent discriminates food or toxins, that this is the rudiment of semiotics or biosemiotics if you will. We shall locate biotic semiosis, as a subcase of information as constraints.

6.3 Adjacent Possible

We argue that natural selection constitutes the assembly machinery, when coupled with heritable variation that literally assembles the propagating organization of matter, energy, constraint, work, and information. This constitutes the propagating organization in autonomous agents, whose coevolution drives the biosphere’s progressive exploration of what we call the Adjacent Possible.

7 Seven Levels of Biosemiosis

Let me close my talk with some very preliminary speculation based on my ideas about the origin and evolution of language and propagating organization as well as a paper by [Hofkirchner \(2002\)](#). This mix of ideas has led me to suggest that there exist at least seven levels of biosemiosis. But first Hofkirchner’s quote that inspired this probe:

“Semiosis and self-organization are co-extensional - there are as many different basic types of semiotic processes as there are basic types of systemic self-organizing processes” (2002: 9).

The seven levels of biosemiosis that will require further study, refinement and possibly expansion are tentatively:

1. the digital transmission of information by DNA from one generation to another;
2. epigenesis of the phenotype from the DNA influenced by signals from the environment;
3. the process by which receptors of prokaryotes interpret signals from the environment;
4. the biosemiosis of learning by virtue of the emergence of a central nervous system in animals;
5. the transition from percept-based thought to concept-based symbolic thought that emerged contemporaneously with human speech;
6. the sociosemiosis of human society or culture, a symbolic based phenomenon; and
7. the semiotics of human generated signs both spoken and notated.

After presenting my ideas Hofkirchner in a private communication pointed out that culture should be added to this list. I agree with him.

This taxonomy is very preliminary and will surely change. It is communicated for the purposes of eliciting comments. If you would like to criticize my scheme or make some suggestions please email me at logan@physics.utoronto.ca. I for one believe there are more levels that further study will reveal.

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