

The Medium is the Message is the Content: Meaning, Media, Communication and Information in Biosemiosis and Human Symbolic Communication

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We wish to distinguish between two forms of communication or the transfer of information in the biosphere, namely biosemiosis in living organisms mediated by the chemical interactions of biomolecules and other forms of physical interactions such as signaling, on the one hand, and human communication and interaction in the form of language and culture mediated by symbols, on the other hand. This study will describe and contrast the nature of meaning, media, content, message, communication and information within these two domains. Before proceeding we need to be clear about the definition of the terms we will make use of as well as understanding the distinction we are making between the symbolic communication and interactions of humans, on the one hand, and the biosemiosis of all other living organisms such as prokaryotes, fungi, plants and non-human animals, on the other hand.

Biosemiosis is the production, communication, affect and interpretation of signs in the biological domain. Some biosemioticians include human communication as part of biosemiosis. For the purposes of this analysis we will not include human symbolic communication and interaction mediated by language and culture as part of biosemiosis. We also make a distinction between non-human animal signaling and human language because the latter is both a symbolic and a generative form of communication while the former is neither. We also make a distinction between human culture and what some call non-human culture, which we prefer to regard as non-human animal social interactions rather than culture. The distinction is that human culture as opposed to non-human animal culture or social interactions is symbol-based as has been pointed out by Clifford Geertz (1973, p. 8). He defines culture as “an historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which men communicate, perpetuate and develop their knowledge about and attitudes towards life.” He goes on to add that, “culture is patterns for behavior not patterns of behavior.”

There are those who will claim that some non-human animals are capable of symbolic language and culture. We will not enter this debate in this paper and dodge this issue as it does not bear on our central thesis but obviously our position is that language and culture are uniquely human qualities as has been previously argued (Logan 2006 & 2007) elsewhere.

Human symbolic interactions are naturally part of the biosphere and are part of the human biotic system but we choose to make a distinction between the purely biological interactions of biosemiosis and human symbolic language and culture where culture includes technology, science, governance and economics. Biosemiosis is instantiated in the biomolecules of which living organisms are composed and the information that is communicated is not symbolic, i.e. standing for something else. It is therefore the case

that the information cannot be separated from those biomolecules. DNA does not symbolize RNA but creates it chemically through catalysis. The same is true of RNA, it is not a symbol of the proteins it creates – it merely catalyzes their chemical composition. The medium and the information content of biosemiosis are identical and hence we will argue that for biosemiosis the medium is the message is the content. Human language and culture, on the other hand is symbolic in which the information is not instantiated materially but is only physically mediated. The information can move from one medium to another. While the human symbolic information of language and culture does not have a material instantiation it does have material effects and entails an abstract cognitive dimension. Just as biotic systems represent an emergent phenomena with respect to the physical components, i.e. the biomolecules, of which they are composed so too human language and culture represent emergent phenomena with respect to the biological components of the brain and the nervous system from which they arise.

In Section 1 we will review the nature of information in the two domains of biosemiosis and human symbolic communication and interaction as mediated by language and culture based on a recent study by Kauffman, Logan, Este, Goebel, Hobill and Shmulevich (2007) entitled *Propagating Organization: An Enquiry* (hereafter referred to as POE). In POE it was shown that the nature of information and propagating organization in biotic systems is quite different than Shannon information used to describe human symbolic information.

In Section 2 we argue that for biosemiosis the information and organization that is propagated in a living organism cannot be separated from the medium in which it is instantiated. In other words the medium and its information content are identical.

In Section 3 we describe the way the symbol-based human activities of language, culture, technology, governance and economics also represent propagating organization as defined in POE. We describe how the medium and its content are independent of each other.

In Section 4 we describe the notion that “the medium is the message” by which McLuhan meant that the effect of the medium, independent of its content, is its message. We also show contrary to many of his critics that McLuhan is not a technological determinist, at least not in the reductionist sense.

In Section 5 we consider propagating organization and the results of the POE study from a media ecology perspective. We make a distinction for human symbolic communication as embodied in language and culture between the content of a medium and the message (or impact) of a medium as embodied in McLuhan’s parable “the medium is the message”. From this perspective the message and the content of human symbolic communication are two different things. This is not the case for the biosemiosis of non-human living organisms because as we will show in Section 2 the medium, the content and the message are all the same. In other words for biosemiosis or the propagating organization of biotic systems “the medium is the message is the content” replaces “the medium is the message” that applies to the media of human culture.

Section 1 - Propagating Organization

In POE we argued that Shannon information does not describe or apply to biotic systems. Instead we defined the information contained in a biological system as the constraints or the instructions by which living organisms carry out their metabolism and replication, i.e. their propagation of organization. We labeled this information as either instructional information or biotic information. We use the two terms interchangeably and note that the term instructional information is used because it describes the function of the information and we use the term biotic information because it describes the domain in which this particular form of information is valid.

Kauffman (2000, p. 4) defines a living organism as “an autonomous agent [that] is a self-reproducing system able to perform at least one thermodynamic work cycle.” It takes constraints on the release of free energy to do work, however, and work to create the constraints. In POE we argued that “the constraints that allow autonomous agents to channel free energy into work are connected to information: in fact, simply put, the constraints *are* the information, are partially causal in the diversity of what occurs in cells, and are part of the organization that is propagated.” Instructional or biotic information are the constraints that direct the flow of free energy to do work. Instructional or biotic information also accounts for the semiotic internal processing of the organism. Examples of biotic or instructional information include DNA, RNA, proteins and detectors for food and toxins in single cell organisms.

The heart of the argument in POE was that Shannon information does not apply to the evolution of the biosphere because it is not possible to prestate all possible Darwinian preadaptations, and hence the ensemble of possibilities of the biosphere and their entropy cannot be calculated. The reason that Darwinian preadaptations cannot be predated is that life is an emergent phenomenon and therefore one cannot predict the behaviour of living systems from the behaviour of the physical particles of which they are made. The configuration space of physical particles that are specified by their position and momentum or velocity is infinite but denumerable. The configuration space of biological systems on the other hand is infinite and non-denumerable. One cannot determine from the knowledge of the physical make up of an organism and its environment the evolutionary emergence of new organs (Kauffman 2000). How could one guess that insect wings used as cooling devices would evolve into organs for flight? Or for that matter that the swim bladder that allows fish to adjust the depth of water in which they swim would evolve into lungs allowing vertebrates to conquer the dry land. This is why the configuration space of the biosphere is infinitely non-denumerable and therefore Shannon’s notion of information is not a valid description of biotic systems. Shannon information for a biotic system is simply a category error.

Another argument made in POE is that for Shannon an organized set like the set of even numbers has less information than a set of random numbers. For a biologist, however, a random soup of organic chemicals has less information and less meaning than an

organized set of organic chemicals that characterizes a living organism that can propagate its organization.

A third argument that can be made is that by Shannon's (1948) own admission his form or measure of information has nothing to do with meaning. He noted, "frequently the messages have **meaning**... these semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one selected **from a set of possible messages**" (emphasis in original). Since the semantics or meaning of the message of Shannon information does not matter it cannot describe a biotic agent, which acts in its own interest and therefore has purpose and hence meaning. A living organism is an autonomous agent, which acts on its own behalf and propagates its organization. This is the nature of its meaning. A random soup of organic chemicals has no organization, no agency and hence no meaning. We may therefore conclude that a central feature of life is organization or to put it more boldly "the meaning of life" is organization —organization that propagates.

The three arguments that have just been presented sum up the basic argument that we made in POE as to why biotic information is not the same as Shannon information.

The reader might be puzzled at this point and ask how is it there can be different kinds of information? Isn't information just information, an invariant like the speed of light? This is not the case as we have just argued. The definition of information depends on the context of the situation that it is describing or representing. Hence there is no conflict between the instructional or biotic information we have defined for biological systems and Shannon information which Shannon defined for engineering purposes. Each has its own place and its own usefulness.

Section 2 - The Medium is the Content: Biosemiosis is a Non-Symbolic Process

There is another essential difference between Shannon information and biotic information namely in the way in which the information is instantiated. Biotic information is instantiated physically in the molecular structures of the organism and affects the organism through the chemical interaction of the molecules of which the organism is composed. Shannon information, on the other hand, is defined independent of the medium of its instantiation. This is the basis of the strong AI notion that human intelligence does not require a wet computer, the brain, to operate but can be instantiated onto a silicon-based computer. The relationship between information and the chemical makeup of the organism is so intimate and intertwined that it is not possible to separate the information content from the medium, as is the case with symbolic information that can be transferred from one medium to another. As was argued in POE one cannot separate the information from the material in which it is instantiated in a living organism. DNA, RNA and proteins are not symbols or signs standing for something else – they are the actual mechanisms by which the organism builds itself, replicates itself, carries out its metabolism and propagates its organization. These molecules are both the medium and

the content and hence the message in the McLuhan sense of “the medium is the message” and also the message in the sense that it is the content of the medium at the same time.

Shannon information on paper, a computer, a DVD or a telecommunication device because it is symbolic can slide from one medium or technology to another and not really change, McLuhan’s “the medium is the message” aside. This is not true of living things. Identical genotypes can produce very different phenotypes depending on the physical and chemical environment in which they operate. Consider the fact that identical twins are not “identical”.

The reason identical twins are not “identical” is that the environment in which the biochemical interactions between biomolecules takes place can alter the outcome. Identical genes can produce different outcomes depending on the environment in which they operate. The environment in which human symbolic information is communicated is the transmitting medium, which can effect the way in which the content is received and interpreted and led McLuhan to formulate the idea that “the medium is the message”. Both biosemiotic and human symbolic information are affected by their respective environments but these two respective environments have quite different characteristics and effects.

Section 3 - Human Language, Culture, Technology, Governance, Economies and Propagating organization

We wish to explore what McLuhan’s aphorism “the medium is the message” can teach us about physically instantiated biotic information systems and human symbolic information systems, which unlike biotic information can be instantiated in a variety of physical systems or media as well as in the human mind. We also wish to compare and contrast these two forms of information.

Human language, culture, science, technology, systems of governance and economies are all examples of human symbolic systems that propagate their organization. They occupy a special place in the biosphere. They are products of human conceptual thought (Logan 2006 & 2007) and represent emergent phenomena. They differ from the materially based information in biological systems in that they are abstract and symbolic and not materially instantiated as such with the exception of technology. In the case of technology it is the concepts and organization that goes into the creation of the physical tools that propagates. Technologies, science, governance and economies are actually a part of culture but we have listed them explicitly because they represent vivid examples of propagating organization.

We might mention that Dawkins (1989) and others have characterized the propagation of language and culture as the replication of memes and that Christiansen (1994, & 1995) and Deacon (1997) have likened language to an organism that Christiansen and Ellefson (2002) have described as “a kind of beneficial parasite—a nonobligate symbiant—that confers some selective advantage onto its human hosts without whom it cannot survive.” I have also generalized Christiansen’s 1994 hypothesis that language is an organism in

Logan (2007) and developed the notion that culture and all its sundry components can also be treated as organisms that propagate their organization.

Language and culture differ from autonomous agents as defined by Kauffman (2000) in that they do not perform any thermodynamic work cycles. They are organisms only in the metaphoric sense that they evolve and propagate their organization. They are after all “beneficial parasites” that derive their energy from their human hosts.

Human language and culture including science, technology, governance and economics all of which are symbolically instantiated represent a higher level of organization and complexity than materially based living organism that perform thermodynamic work cycles. They emerge from the biological properties of their human hosts. Language and culture are symbolic and conceptual and not material but they nevertheless propagate their organization.

Section 4 - The Medium is the Message

McLuhan developed his notion of “the medium is the message” through his consideration of the effects of technology and different forms of media on human communication and behaviour. It was a way for him to explore the impact of technologies and media independent of their content and represented a new way of understanding the effects of media and technology that differed from the content analysis approach that dominated the pre-Innis/McLuhan study of communications and technology.

Like most good aphorisms, McLuhan's famous dictum has more than one meaning. One meaning is the notion that, independent of its content or messages, a medium has its own intrinsic effects on our psyches, our associations and our actions, which are its unique message. "The message of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs." McLuhan cites the way the railway created "totally new kinds of cities and new kinds of work" (McLuhan 1964, 8). What McLuhan writes about the railroad applies with equal force to the media of print, television, the microcomputer and the Internet. "The medium is the message" because it is the "medium that shapes and controls the scale and form of human association and action" (McLuhan 1964, 9). The effects of a medium impose a new environment and set of sensibilities upon its users.

"The medium is the message" also carries the notion that a medium transforms its message or content. A movie shown on television or a play that is filmed affects its audience differently from the original. Even a telephone conversation on a cell phone is different than one on a landline.

Some critics of McLuhan take his famous aphorism literally forgetting that McLuhan enjoyed putting on his audience by shocking them. When McLuhan was first developing his ideas content analysis was king among communication scholars. McLuhan wanted to shake up the field and the best way to do that was through paradox to wake people up to

the fact that the medium has an effect independent of its content hence his formulation: “the medium is the message”.

Some naïve detractors of McLuhan dismissed the “medium is the message” arguing simply that the content is the message as this was the basic assumption of their content analysis approach to the study of communications. Others accused McLuhan of being a technological determinist. It is easy to see how they could arrive at such a misconception because he did in fact show that media and technologies in general do have causal consequences. He did not, however, regard technology as the sole factor that transforms society. He was an interdisciplinarian and believed that there were many factors contributing to societal transformation.

Evidence of his broad perspective is his description of an insight as “the sudden awareness of a complex process of interaction,” which is how he regarded the relationship between media and society. "We live today in the Age of Information and Communication because electric media instantly and constantly create a total field of interacting events in which all men participate" (McLuhan 1964, p. 248). A field approach rejects the notion of a linear cause and effect model, which characterizes naïve ‘technological determinism’. McLuhan adopted a “total-field-theory approach”. He recognized the non-linear aspect of the relationship between media and society and in a certain sense foreshadowed the notion of co-evolution and complexity or emergence theory.

Section 5 - The Medium is the Message is the Content

Does McLuhan’s one liner “the medium is the message” and the insight it provides for understanding media and technology have any relevance for understanding biotic systems and their biosemiosis.

A number of authors have made use of biological models to better understand the development of technology. Basalla (1988), a historian, in his book *The Evolution of Technology* makes excellent use of evolutionary biological metaphors to explain the way in which our technosphere has developed, progressed and yes, evolved.

The renowned biologist John Maynard Smith (2000) has also noted a parallel between technology and biology:

I have become increasingly convinced that there is no way of telling the difference between an evolved organism and an artifact designed by an intelligent being. Thus imagine that the first spacemen to land on Mars are met by an object which appears to have sense organs (eyes, ears) and organs of locomotion (legs, wings). How will they know whether it is an evolved organism, or a robot designed by an evolved organism? Only, I think, by finding out where it came from, and perhaps not even then.

Van Alstyne and Logan have made use of this analogy of biology and technology to better understand the process of technological emergence, innovation and design (Van Alstyne and Logan 2007 and Logan and Van Alstyne In preparation).

An understanding of biology has helped us to better understand technology and its design, emergence and evolution. But can we reverse the flow of understanding so as to make use of an insight about the nature of technology and media using McLuhan's aphorism "the medium is the message" to better understand biological systems and the way they propagate their organization.

McLuhan (1964) pointed out that media and technologies are extensions of man. He entitled his groundbreaking study of media *Understanding Media: Extensions of Man*. He also argued that man is the servomechanism of his tools. "By continuously embracing technologies, we relate ourselves to them as servomechanisms (ibid. p. 46)." If we accept McLuhan's notions that media are extensions of man and man is the servomechanism of his media then it follows that humans and media are extensions of each other and share certain similarities. If humans are a form of media then so are other forms of life and we arrive at the conclusion that living organisms are a form of media. Furthermore if a living organism is a medium and the medium is the message then we may ask what is the message of a living organism — why, it is the propagation of its organization.

To see how McLuhan's ideas may be applied to biology we need to ask the question first raised by Greg van Alstyne in a private conversation, namely, what is the difference between the message and the content? The difference is that there are two messages of media and technologies according to McLuhan – one is the effect of the medium independent of the content and the other is the content of the medium itself. In the transfer or communication of information in biotic systems, i.e. in biosemiosis, the medium is the content in that the information that is transmitted derives from the biochemical interactions of the biomolecules of which the organism is composed. The chemical interactions of the media of DNA, RNA or proteins are the content, the constraints, the information and therefore the message. The effects of these media are due to their content and are their message. The content and the message are the same thing hence for biotic information "the medium is the message is the content". Thus McLuhan's understanding of media provides us with an insight into the role of information in biology and the way in which biotic systems propagate their organization.

What exactly do we mean by the statement: the medium is the message is the content? We mean that for biotic systems not only is the medium the message in the McLuhan sense that a medium has an effect independent of its content but the medium is also the content because it is the chemical properties of the medium that affects the organism. In fact the medium is the message because it is literally the content and the content of the message is unique to that medium and is instantiated in it and it cannot be transferred to another medium. To repeat it is not possible to transfer the content or the message of the medium to another medium. There is an isomorphism between the medium and its content. The medium is the content and hence also the message. The medium is both the message and the content for a biotic system. Information in a biological system is not symbolic. The information coded in the chemical alphabet of biomolecules that make up

living organisms acts through the chemical interactions of those biomolecules. It is not the symbolic nature of DNA that gives rise to messenger RNA and it is not the symbolic nature of RNA that gives rise to proteins but rather the chemical properties of DNA that produce RNA and the chemical properties of RNA that produce proteins and the chemical properties of proteins that carry out their various functions of the proteins such as:

1. serving as enzymes to catalyze biochemical reactions vital to metabolism,
2. providing structural or mechanical functions, such as building the cell's cytoskeleton,
3. playing a role in cell signaling, immune responses, cell adhesion and the cell cycle

Conclusion

At the beginning of this paper we said we would contrast the nature of meaning, media, content, message, communication and information within the two domains of biosemiosis and human symbolic communication.

The meaning of language and culture depends on the conscious intentions of the human agents that make use of them. The meaning of biosemiosis is the organism's propagation of its organization. For language and culture "the medium is the message" whereas for biosemiotic interactions "the medium is the message is the content". Biosemiotic communication is biochemical whereas human verbal communication is symbolic. And finally, as we argued in Section 1, the information of biosemiosis is instructional or biotic while that of humans is symbolic and Shannon-like.

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