THE IMPOSSIBLE, THE UNTHINKABLE: INFORMATION IS CHOICE

Robert Johannson
22 – 30 Spence St. Winnipeg, Manitoba, Canada, R3C 1Y1
204-775-5436, robert_johannson@hotmail.com

ABSTRACT

In 1948 Norbert Wiener wrote “Information is information. It is not matter or energy. No materialism that does not admit this can survive at the present time.” The materialism “that does not admit this” is mechanistic reductionism, the belief that all phenomena can be reduced to matter and energy processes.

Mechanistic reductionism is based on Aristotelian metaphysics that “substance” is really real because it does not change, and qualities or “accidens” are not real because they change. Thus matter and energy are real because they are universal constants. But information is subject to change and thus is not objectively real. For cybernetics and telecommunications, information is objectively real.

In telecommunications and computing, information is a choice. Choices can be stored in the binary state of a transistor. A transistor can be used as a gate with two possible states: open or closed. The choice of state is the information and it is measured in “bits,” the number of binary choices.

Choice is a challenge to the scientific method. The scientific method is a way to test a hypothesis to see how accurately it can predict the results of an experiment. Does the hypothesis reveal a cause and effect relationship? But if actions are also the result of choices then the future depends on decisions that haven't been made yet. The scientific method instead of being the road to all truth becomes a useful method for identifying some cause and effect relationships.

If information is a choice then scientific knowledge is not the rational understanding of objective truth, but only models chosen for various reasons to illuminate specific aspects of the environment, and subject to change.

The advantage to the modern definition is that it is clear, simple, useful, and gives us a basis for understanding holistic systems. Holistic systems are information systems. Since information is a choice it can also function as a command. Control systems are decision making systems. The basic information process is the translation of choices in one set into choices in another set. The translation process is a command and thus is also information, but at a program level. Because information is categorical, it is also hierarchical. The basic choice, either/or, creates a difference that forms a category. When two self-controlled systems meet, since they are information systems, they communicate. They become part of a larger whole that contains them both. The individuals will begin to define functional roles to achieve a more effective control process for the whole. Since the parts are themselves wholes they form nested holarchies. Since a control process is an information process, there is the possibility of communication between the levels of the holarchy, creating hierarchical control systems. This process of communication allows information systems to evolve and grow new and more complex forms. Since

communication is a process of translation and decay, holistic systems have a life cycle: genesis, growth, maturity, decline, disintegration.

Keywords: information, holism, reductionism, cybernetics, communication

INFORMATION VS REDUCTIONISM

In 1948 Norbert Wiener wrote "Information is information. It is not matter or energy. No materialism that does not admit this can survive at the present time." (Wiener, 1948, p.155) The materialism "that does not admit this" is mechanistic reductionism, the belief that all phenomena can be reduced to matter and energy processes or mechanisms.

Mechanistic reductionism is based on Aristotelian metaphysics developed by the monks in the Middle Ages. Everything in the universe consists of substance and form. It argues that "substance" is really real because it does not change, and forms or "accidens" are not real because they change. Thus a lump of clay can be shaped into a cup, or a bowl, or a sculpture. The clay remains the same, but its form can change depending on the choice of the potter. Thus the bowl is only real because the clay is real.

By extension matter and energy are real because they are universal constants. Thus processes can be described with equations. But information because it is form is subject to change and thus is not considered objectively real. With the advent of Newtonian mechanics this became science dogma. Since only matter and energy were real, and they could be described with mathematical equations therefore the world was merely a mechanism, and all phenomena could be reduced to a mechanistic formula.

The advantage of this kind of metaphysics is immediately obvious. It makes the world predictable. The wonder of Newtonian mechanics was that by the use of equations one could accurately predict the future: $F = ma$, $E = mc^2$, $K.E. = mv^2$. It allowed the space program to put a man on the moon.

It is a short step from there to saying that since matter and energy are the only really real, then everything real is made up of matter and energy, and since they are predictable, then everything that happens is theoretically predictable, and thus determined. Everything remains the same until it is forced to change. To understand change, simply identify the "forces" that caused it.

This is the basis of the scientific method. Develop an hypothesis. Design an experiment to test the hypothesis. Do the experiment. Observe the results. The scientific method is a way to test a hypothesis to see how accurately it can predict the results of an experiment. Does the hypothesis reveal a cause and effect relationship? The unspoken assumption is that all of reality can be described by cause and effect relationships which can be expressed mathematically.

This materialism is the basis of the Roman Catholic dogma of transubstantiation. The bread and wine of the Eucharist are transformed into the "substance" of the body and

blood of Christ, but they retain the form, taste and texture of bread and wine. Thus although they taste like bread and wine they are "really" the body and blood of Christ.

Empiricism has always had a problem with this on the general principle that if it looks like a duck, quacks like and duck, and waddles like a duck, it's a duck.

There is an empirical definition of information that is not dependent on Aristotelian metaphysics.

INFORMATION IN COMMUNICATION

There are numerous definitions of "information" to suit various uses. But the information Wiener is referring to is information in the cybernetic or communications context.

In telecommunications and computing, information is a choice. The empirical definition developed at Bell Labs is that information is "a message *selected from a set* of possible messages." (*italics* in the original) (Shannon, 1948).

For example: given the 26 possibilities of the alphabet, the choice of an "m" is information. The information is the choice.

The classic formula for quantifying information is the formula: $H=n\log_2 S$ where H is the quantity of information in "bits;" n is the number of symbols; $\log_2 S$ is the logarithm to the base two (rounded up) of S; and S is the number of symbols in the symbol set. The logarithm to the base two counts the number of binary choices it takes to code the information. In telecommunications and computing, information is a choice.

It is important to note that in this definition there is no matter in grams, or energy in watts. Also in this definition there is no meaning. The count refers simply to the number of choices. The meaning of the information is the set that the information is chosen from. Thus the letter "m" has no meaning in itself. Its meaning comes from being part of the set of symbols that is the alphabet.

The cyberneticist Gregory Bateson in his famous Korzybski Lecture defined information as "a difference that makes a difference." (Bateson, 1972) Like Wiener, Bateson's information is not matter or energy. A difference has neither matter nor energy. Bateson's definition of information as a difference also has no meaning. The

basic unit of difference is the binary either/or, which is also the basic binary unit of choice. A difference that makes a difference is a convoluted way of describing a choice. It makes a difference because it is chosen or selected.

The team at Bell Labs, of course, won the Nobel Prize for the invention of the transistor. The problem for Bell Labs was to come up with a way to automate the numerous switches needed in a telephone exchange. A transistor can be used as a gate with two possible states: open or closed. Thus a telephone number is a set of choices that can act as a series of commands that activate a number of transistor gates.

Any complex choice can be coded as a series of binary choices, usually symbolized by 0 and 1. Thus, in ASCII A = 01000001. In a computer choices can be stored in the binary state of a transistor. The choice of state is the information and it is measured in "bits," the number of binary choices.

Modern science has recognized the problem of choice in a number of different ways. The advent of statistical analysis has made prediction more complicated, but the goal of prediction remains the same. The statistical discovery was that if a specific variable in a specific set tends to have a distribution that follows a Gaussian or bell shaped curve, then it can be considered a random variable. Therefore it is possible to make a prediction for the distribution if not for the individual elements. This allows people to make money on games of chance or quantum mechanics.

The deterministic assumption remains, that if the distribution does not in fact follow the probability curve then it is not a random variable and is being controlled by some causal process. And once again the unspoken assumption is that since only matter and energy are "real" then it must be some form of energy process.

Since both information and statistical probabilities are calculated from a set of possibilities there is often confusion about the difference. Some people even think that information is a probability function. The difference is that information is measured in bits and probabilities are measured in fractions. Thus a coin has two possibilities: heads or tails. The probability that it will turn up heads is one out of two or 0.5. Similarly the probability of it turning up tails is one out of two or 0.5. If you flip the coin it will turn up either heads or tails. Heads you can code as 1 and tails you can code as 0, which is one bit. A difference makes a difference because it is chosen.

For cybernetics and telecommunications, information is objectively real. A choice once made is not a possibility but a fact. Thus, with the toss of a coin, before the toss, there are two possibilities: heads or tails. After the toss the resulting heads or tails is a fact. The choice is objectively real. Before having breakfast, there are possibilities: porridge or eggs. After the egg is eaten, my breakfast is a fact. Gamblers could place bets on what I am going to have for breakfast tomorrow. If it's Sunday, then a mushroom omelet is a good bet. But I could change my mind. It's my decision. Thus it is probable, but not determined.

Choice refutes determinism. In Newtonian mechanics everything can be describe in terms of quantities of matter and energy and can be described in mathematical equations because matter and energy are universal constants. The striking thing about Newtonian mechanics is that everything remains the same, until it is forced to change. Thus to understand change the mechanistic thinker looks for the forces that caused it. But if actions are also the result of choices then the future is not perfectly predictable, but depends on decisions that haven't been made yet.

Choice is a challenge to the scientific method. The scientific method is a way to test a hypothesis to see how accurately it can predict the results of an experiment. Does the hypothesis reveal a cause and effect relationship? The presupposition is that the universe is a mechanism of cause and effect. But if actions are also the result of choices then the universe is not a deterministic mechanism, and the future depends on decisions that haven't been made yet. The scientific method instead of being the road to all truth becomes a useful method for identifying some cause and effect relationships.

If information is a choice then scientific knowledge is not the rational understanding of objective truth, but only models chosen for various reasons to illuminate specific aspects of the environment, and subject to change.

INFORMATION AND HOLISTIC SYSTEMS

The advantage to the modern definition is that it is clear, simple, useful, and gives us a basis for understanding holistic systems. Communication systems are information systems. Matter and energy are the media of information and communication. Control systems are information systems. Information controls matter and energy. Holistic systems are information systems. Information is systemic.

Communication Systems are Information Systems

Since information is choice within a set, communication consists of translating choices in one set of possibilities into choices in another set, in other words coding, or what the mathematicians call “mapping.” The choice of ideas is translated into the choice of words which is translated into the choice of sounds which is translated into the choice of words which is translated into the choice of ideas. Or the choice of words is translated into the choice of letters of the alphabet which is translated into Morse Code which is translated into electrical pulses which is translated into clicks.

Although information consists of choices in a set and has no meaning as such, the meaning is in the reference. Thus the map is not the territory, but the territory is the meaning of the map. Thus the clicks mean electrical pulses which mean Morse code symbols which mean letters which mean words which mean ideas. Meaning is a relationship.

Information is Choice

Modern telecommunications is based on the understanding that matter and energy are the media of information and communication. Thus, ideas in the medium of the brain are translated into waves in the medium of sound which are translated into waves in the medium of electricity which are translated into wave forms in electro-magnetism. Or for the telegraph, ideas in the medium of the brain are translated into letters of the alphabet in the medium of ink on paper which are translated into Morse code taps on a telegraph key which are translated into clicks in the medium of a telegraph receiver.

Understanding information process as a translation process allows us to understand harmonic communication. The goal of communication is harmony. Communication involves translating different meanings. For my ideas to communicate with your ideas, the language that I use as a medium must be a language that harmonizes with your language. We have to speak the same language. But even if the words are the same, we may differ significantly in the way that we translate them into ideas.

Why is it so hard to make voice recognition software? The problem is that we were taught that the letters of the alphabet are symbols for sounds. This is not quite true. The letters of the alphabet are symbols for phonemes. It turns out a phoneme is not a sound, but a set of distinctions between sounds. When a child first learns to talk it begins with "mama," or "dada." This is the point at which the child has learned to distinguish between a vowel, and a consonant. This is a decision, a distinction. The child is working at dividing the linguistic world into vowels and consonants. The child then has created a set of options and is playing with using that distinction in order to communicate and to learn. What sound does that particular way of tightening the larynx and shaping the mouth create? What do I have to change to make the distinction clearer? We, of course, focus on the response from the parents, but the actual learning is self-reflection.

We were all raised with the idea of teaching as a tabula rasa. The child is a blank slate on which the teacher writes. University teaching is a process of transferring the notes in the professor's notebook, to the student's notebook without passing through the mind of either.

What I discovered in doing supervision of students was that it does not consist of giving them your wisdom, but of listening to them learn. But that requires an understanding of systems of self-control.

Control Systems are Information Systems

Since information is a choice it can also function as a command. A command causes change to happen. Information and communication control matter and energy. The brain processes information and controls the muscles that process energy. The thermostat processes information and controls the heater which processes heat.

Control systems are decision making systems. All control systems go around a basic cybernetic information loop: act, sense, evaluate, choose, act. The military refer to this decision process as an OODA loop: Observe Orient, Decide, Act.

Information is Choice

Each of the individual processes around the control loop is an information process. The basic information process is the translation of choices in one set into choices in another set, translating one form of information into another form of information.

In diagrams the box can be a symbol of the translation process, and the arrow can be a symbol of the information input and output.

Since information is a choice it can also function as a command. The translation process is a command and thus is also information, but at a program level.

A cybernetic control system is an information process where one form of information is translated into another. Sensing consists of models that translate changes in the environment into perceptions. Evaluating consists of values that translate perceptions into needs. Choosing consists of options that translate needs into action. Acting consists of the environment translating action into changes. Models, values, options and the environment are the translation processes that constitute the program that controls the control process.

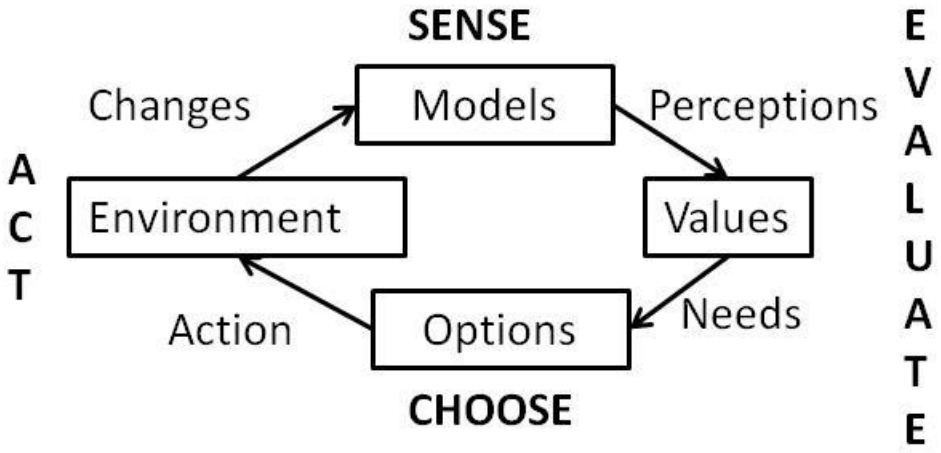

Figure 1. The Cybernetic Control Loop

The constant practice of a skill always has those four sides. There is the increasing sensitivity to small distinctions in the environment. The sensitivity is the perceptual aspect which is the ability to actually hear or see or feel the distinction: deciding which of these things is not like the other; developing a model. Then it involves the ability to evaluate the sensations: which sounds better? The evaluation of the results allows for the development of increasing options for muscular control, and thus a steadily increasing self-control and environmental control.

What I discovered in doing supervision of students was that it does not consist of giving them your wisdom, but of listening to them learn. By listening I can give them feedback on how they are perceiving their options. I become part of their feedback loop that allows

them to control their skills. As options become clearer the process of values clarification can happen. What choice is best according to my values and purposes?

The translation process or program operates at a logical level above the initial information. It is a meta-language, a holistic system. Learning happens at the meta-level.

Holistic Systems are Information Systems

Information is logical. The binary choice is the basis of symbolic logic. Information is categorical. The basic choice, either/or, creates a difference that forms a category. It is symbolized by the Venn diagram where the choice is represented by a boundary line separating the x from the not x. Since wholes are logical categories they also intersect to form complex wholes. The normal use for a Venn diagram is to show the relationships between categories. It can also be used to diagram the syllogisms in traditional Aristotelian categorical logic.

A system is defined by a boundary that divides the universe into the system and its environment. The system has an identity as a whole distinct from its environment. It is holistic.

When two self-controlled systems meet, since they are information systems, they communicate through their shared environment. They become part of a larger whole that contains them both, symbiosis. This process of communication and symbiosis allows information systems to evolve and grow new and more complex and more abstract forms.

The larger cooperative is also a control process. A whole has parts that serve the basic functions of the whole. Now that the individuals have become part of a large whole, they will begin to define functional roles to achieve a more effective control process for the whole.

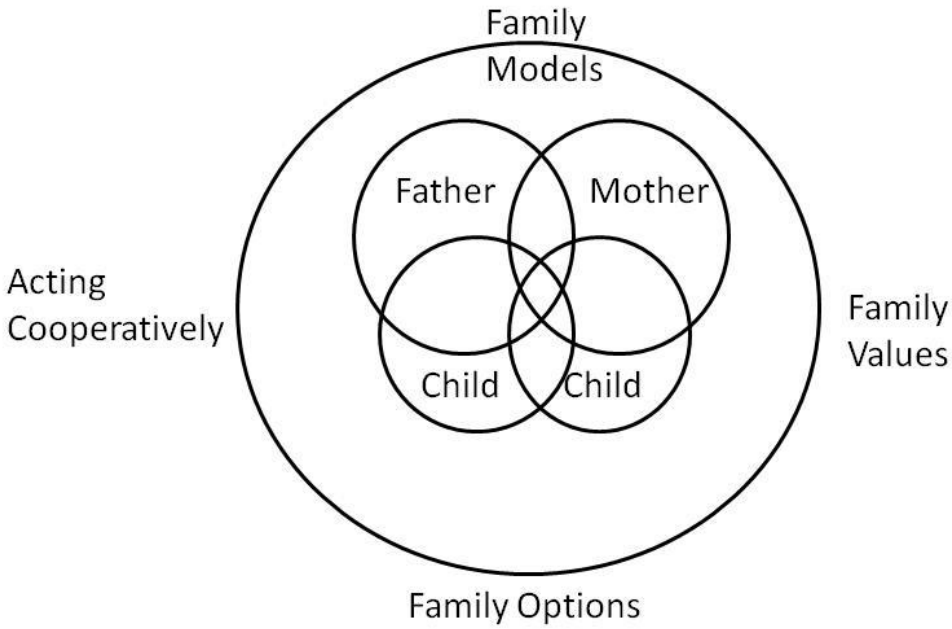

Figure 2. Functional Roles

Because information is holistic, it is also hierarchical. Each of the parts is also a whole to its own parts. Arthur Koestler coined the term "holon" to describe this dual quality of wholes. Since the parts are themselves wholes they form nested holarchies.

Since a control process is an information process, there is the possibility of communication between the levels of the holarchy, creating hierarchical command and control systems. These systems are dialogical.

Since communication is a process of translation, it is also subject to decay, from errors in coding, errors in decoding, and the effect of noise on the medium. The control of the environment that the system has achieved will lead to growth. But because of the decay of information, holistic systems have a life cycle: genesis, growth, maturity, decline, disintegration.

The advantage of the modern definition of information as choice is that it is clear, simple, quantifiable, useful, and gives us a basis for understanding holistic systems. But it means relegating mechanistic determinism to the dust bin of Science.

REFERENCES

Bateson, Gregory (1972). *Steps to an Ecology of Mind*., Chandler Publishing Company, San Francisco, p.484 https://www.generalsemantics.org/wp-content/uploads/2011/04/gsb-37-bateson.pdf

Koestler, Arthur (1967). *The Ghost in the Machine*. The Hutchinson Publishing Group, London. https://books.google.ca/books/about/The_Ghost_in_the_Machine.html?id=tJS-QgAACAAJ

Shannon, Claude E. (1948). "A Mathematical Theory of Communication," *The Bell System Technical Journal*, Vol. 27, pp. 379–423, 623–656, July, October. http://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf

Wiener, Norbert (1948). ***Cybernetics: or Control and Communication in the Animal and the Machine.***, The Technology Press, New York, p.155. https://mitpress.mit.edu/books/cybernetics-or-control-and-communication-animal-and-machine-reissue-1961-second-edition