FCJ-079 Regaining Weaver and Shannon

Gary Genosko, Lakehead University, Thunder Bay, Canada.

2 My claim is that communication considered from the standpoint of how it is modeled must not only reckon with Claude E. Shannon and Warren Weaver but regain their pioneering efforts in new ways. I want to regain two neglected features. I signal these ends by simply reversing the order in which their names commonly appear.

3 First, the recontextualization of Shannon and Weaver requires an investigation of the technocultural scene of information 'handling' embedded in their groundbreaking postwar labours; not incidentally, it was Harold D. Lasswell, whose work in the 1940s is often linked with Shannon and Weaver's, who made a point of distinguishing between those who affect the content of messages (controllers) as opposed to those who handle without modifying (other than accidentally) such messages. Although it will not be possible to maintain such a hard and fast distinction that ignores scenes of encoding and decoding, Lasswell's (1964: 42-3) examples of handlers include key figures such as 'dispatchers, linemen, and messengers connected with telegraphic communication' whose activities will prove to be important for my reading of the Shannon and Weaver essays. Telegraphy and its occupational cultures are the technosocial scenes informing the Shannon and Weaver model.

4 Second, I will pay special attention to Weaver's contribution, despite a tendency to erase him altogether by means of a general scientific habit of listing the main author first and then attributing authorship only to the first name on the list (although this differs within scientific disciplines, particularly in the health field where the name of the last author is in the lead, so to speak). I begin with a displacement of hierarchy and authority. I am inclined to simply state for those who, in the manner of Sherlock Holmes, 'know my method', that I focus my attention on the less well-known half of thinking pairs – on Roger Caillois instead of Georges Bataille, on Félix Guattari rather than Gilles Deleuze. In the absence of my own sympathetic Watson, I will provide two detailed accounts of the effects of this reordering of names and reprioritizing of features. Weaver's task was to communicate about the mathematical model in non-technical terms; he did this in the original writings on the model and much later in his career as a scientific proselytizer. He was assigned this later task by the president of the Rockefeller Foundation and didn't realize, by his own admission, was he was getting into; yet, he managed to produce several versions of explanatory texts as well as theorize about popular scientific writing (Weaver, 1967). This displacement of authority allows me to circle back to an older technology, namely telegraphy, that newly figures in the regained history of the mathematical model I am offering here. This both unfixes the scholarly preoccupation with telephony under the sign of Ma Bell, and foregrounds the service environment of the telegram office that influenced the model in the first place and recurred in later reflections on it in the second place.

The Mathematical Model of Communication Revisited

5 The celebrated Shannon and Weaver (1964; orig. 1949) model of communication was described in two essays dating from 1948 and −49: Weaver's 'Recent Contributions to the Mathematical Theory of Communication' and Shannon's 'The Mathematical Theory of Communication'. Shannon's work was undertaken in the laboratories of Bell Telephone and was originally published in the Bell System Technical Journal. These two essays are classics of information and communication theory and, even though it is Norbert Wiener who is mentioned most often in connection with the development of statistical communication theory and cybernetics, Wiener credits Shannon with generating his own interest in the field. He can be, however, less generous and probably more accurate in noting that the engineering approach to communication based on statistical theory was an 'idea [that] occurred at about the same time to several writers' (Wiener, 1962:10). It is not unreasonable to think of this discovery in terms of simultaneity and complementarity.

6 Scholars in the area of information theory with an interest in the work of both Shannon and Weiner separate them on the basis of the two concepts that will play a large role: encoding and decoding. Robert Ash (1965: v), for instance, writes:

7 > The Shannon formulation differs from the Wiener approach in the nature of the transmitted signal and in the type of decision made at the receiver. In the Shannon model, a randomly generated message produced by an information source is encoded, that is, each possible message that the

source can produce is associated with a signal belonging to a specified set. It is the encoded message that is actually transmitted. When the output is received, a decoding operation is performed, that is, a decision is made as to the identity of the particular signal transmitted. In the Weiner model, a random signal is to be communicated directly through the channel; the encoding step is absent. The decoder in this case operates on the received signal to produce an estimate of some property of the input. In general, the basic objective is to design a decoder that makes the best estimate.

8 Of course, there are other significant differences and similarities (how the channel is modeled, for instance, and the scale adopted for addition and multiplication – two rather than ten – which Weiner borrowed from the Bell Labs) between the Shannon and Weiner models, but they do not concern me here. It is worth noting, however, that the production of an identity between encoded messages by decoders remains a fundamental problem in communication, no matter if we are considering signal accuracies or the asymmetry (non-identity) between meaning structures at either end of the model.

9 Shannon's inclusion of an encoding step, and the need to follow-up on it but in reverse at the decoding end, reveals that the mathematical model is at the very least labour intensive. Roman Jakobson (1990: 495-96), it may be noted if only in passing, took great care in exploring the many points of contact between information and communication theory while respecting their respective autonomy. He points out, for instance, that the same issue of meaning had bedeviled communication theory and linguistics until both finally overcame their mutual tendency to exclude it and set about tackling its relation to context.

10 My focus is on the problems outlined in Weaver's paper with occasional references to Shannon. The reason for this is simple. It is the commentary on general problems rather than the mathematical expression of the model itself that provides the backdrop against which subsequent deployments of it in a variety of cultural domains may be best appreciated. Weaver approaches communication in a most general way in terms of a broad statement about minds affecting other minds by means of various technical procedures. For Weaver, communication poses problems at three levels: technical, concerning the accuracy of transmitting a finite set of symbols conceived as an engineering problem (accuracy); semantic, a concern with the precise conveyance of meaning, posing the problem of identity between intended and received meaning (philosophical problem); and effectiveness, i.e. does the received meaning have the desired effect on the decoder, influencing his or her conduct (again, another philosophical issue, but one obviously not far from marketing)? It is to the first level that Weaver directs his attention.

11 At the level of technical communication, the two-terminal model presents an information source from which issues a message to a transmitter that sends a signal through a channel subject to a certain amount of noise. The signal is received by a receiver, which delivers the message to its final destination. Ultimately, my interest will fall on the receiver's decoding practices rather than the transmitters encoding of a signal into a message. Weaver's model presents both problems because it doubles the efforts of communication at both terminals of the model. The information source, to begin with, involves the selection of a message out of a set of possible messages (the message may consist of words, pictures, music, etc). The transmitter changes or translates the message into a signal; the signal is sent through a communication channel from the transmitter to the receiver. On the encoding side, messages are selected, translated, and then transmitted. The process is threefold. The media referent for the model is telegraphy, involving the selection of a message consisting of written words and its translation into a series of dots, dashes and spaces. The receiver on the decoding side must share this code and functions, as Weaver (1964: 7) puts it, as an 'inverse transmitter'. Sometimes, noise gets into the transmission. It is unwanted and distorting, adding or subtracting from the signal, thereby creating uncertainty about the message. As for the message itself, the transmitter encodes it from an information source. Despite the technical nature of the representation, the interpersonal drama of the situation is fairly obvious: a message is delivered to an operator who then translates it into a shared technical code; the alphabet translated in Morse telegraphy consists of dots and dashes used in mechanical transmission, but what comes through at the other end, either recorded on paper or heard by the operator, needs to be converted, written out in longhand and delivered – sometimes by messenger boys to the homes or offices of off-site recipients. The prose style was known as telegraphese, a terse, clipped English for the most part written in longhand, but pared down to its

essentials. This is a subcode within the encoding operation that Weaver neglects to mention, upon which may be grafted other subcodes (ciphers and private codes) and other decodable features of the communication.

12 The other two levels raise semantic issues and call for the invention, in Weaver's (1964: 26) estimation, of a semantic receiver that is interposed between the engineering receiver (changing signals back into messages) and the destination. There is implicit in this communication a chain of command that will become clear in a moment. The addition of a second decoding has the goal of 'match[ing] the statistical semantic characteristics of the message to the statistical semantic capabilities of the totality of receivers, or of that subset of receivers that constitute the audience one wishes to affect' (Weaver, 1964: 26). Implied here is the need for sensitivity to small groups of receivers, but in the language of matching statistically the characteristics of messages with the capacities of audiences. The idea of the capacity is particularly rich (Weaver, 1964: 27) and relevant to the lecturer: it works on the analogy of crowding too much information over a channel since, no matter how efficient and clean the encoding, it is still possible to both overwhelm the channel and overburden the audience's capacity to receive the message, or what remains of it. Overstimulating the audience will also produce error and confusion. Of course, this is conceived of statistically. Capacity often pertains only to the channel as a piece of technical equipment defined mathematically and not at all to a specific scene of cultural communication (lecture) or message content. As Colin Cherry develops the concept, information capacity is Shannon's great expression of a maximum that gathers the features of time, bandwidth, and signal power, with the addition of a noise rate. I concur with Cherry (1966: 41) that 'perhaps the most important technical development which has assisted in the birth of communication theory is that of telegraphy', but there is more going on in this admission than technical description.

13 Information theoretical models of communication were little concerned with meaning and not at all with individual messages, being instead most concerned with the statistical characteristics of messages. To put it bluntly, information is not meaning: engineering triumphs over semantics. What could be said is more interesting than what is said because the analysis of informational units called bits, the selection and combination of which is subject to degrees of freedom and constraint, are described by a logarithm (x is the logarithm of y to the base m). If one begins with the base m = 2, with x the number of alternatives, this tells you the number of bits of information, y (if the base is 2 and the alternatives are 16 then there are 4 bits of information). It is not my intent to follow Weaver as he clears the ground for the statistical study of language. I will rather focus on the social scene of the communication in relation to the engineering or statistical approach to communication.

14 It turns out, upon close examination, that the social scene of the engineering problem of communication is stratified in various ways, the most obvious of which is by gender in a service environment. Weaver (1964: 27) writes:

15 > An engineering communication theory is just like a very proper and discreet girl accepting your telegram. She pays no attention to the meaning, whether it be sad, or joyous, or embarrassing. But she must be prepared to deal with all that come to her desk. This idea that a communication system ought to try to deal with all possible messages, and that the intelligent way to do this is base design on the statistical character of the source, is surely not without significance for communication in general.

16 Shannon remarked at the outset of his paper that semantics are irrelevant to engineering. Rather, the focus is on the selection of the message from a set of possible messages. In terms of Weaver's analogy, the telegraph girl should be discreet and have no interest in meaning, which is say, in content; her task is to translate English (or whatever language) into code and then, all things being equal, have someone like her down the line de-code the information into telegraphese. The social scene here is a service environment (the telegraph office, indelibly stamped with the Western Union name), but in the military and/or business chain of command, orders are issued by superiors and delivered for execution by employees at the telegraph desk where dispatches are relayed. Translation of the message is a gendered activity (Martin, 1991) that requires compliance, discretion and, above all else, suspension of moral interest. Yet no person has ever been completely separate from meaning, that is, a pure handler. Not even the analogical telegram girl conjured by Weaver.

17

If the encoder is a discreet girl, then who is the receiver? This is a question that becomes important as soon as one senses that the non-mathematical dimensions of the mathematical model have a gender and a hierarchy of power/knowledge. The receiver as the one who reconstructs backwards the messages from the signal, but the destination is the person for whom the message is intended. The receiver is not the destination. The receiver is another telegraph operator low in the hierarchy who then gives the message (via intermediaries) to 'her' superiors or customers. The model of communication is subject, then, to meta-modeling operations around gender and chain of command (or at least a service environment). This side of the model is stratified – or to use a less sociological term – staggered. This was already evident in early technologies like the vocoder (analysis and compression on the encoding side and resynthesis or reconstitution of speech at the decoding side) (Cherry, 1966: 45). At the heart of the engineering model is the figure of a discreet girl whose activities should pique the interest of those who would dismiss the model because it offers nothing greater than a statistical description of the transportation and transmission of messages. One of the contributions to the understanding of telegraph culture made by popular science writers (Standage, 1998) is the extent to which the profession was stratified by speed (sending and receiving messages), by urban versus rural locations (the former highly valorized, and the latter stereotyped as slow and backwards), and by gender as it was decoded flush with technology (the allegedly 'lighter' touches of women's fingers on the Morse keys), and within the array of informal communications among members of the telegraphic community. The emphasis is on affective textures and sociability in the telegraph operator subculture. At the same time, many accounts of telegraphy in the history of communications are bewitched by the purely technical aura of the electrical sciences, the triumph of trans-Atlantic cables, and the advent of wireless. It is now common for historians to compare and contrast telegraphy with the Internet (Winseck, 2004).

18 Let's return to the technical problem of noise. What is to be done about noise in the channel? How does one combat this chance variable? The issue is formulated this way: the received signal E is a function of the transmitted signal S and the variable N, so that E = f(S,N). The Shannon and Weaver solution is to situate an auxiliary observer in the communication model. This observer-device surveys what is sent and received, noting the errors, and transmitting data about them over a correction channel so that the receiver can make the corrections. Correction is a clean-up operation, a secretarial function. Cleaning-up the message adds meaning. In between the information source and the transmitter, the original message branches off and upward toward an observation device, back to which flows the corrections concerning the received message from the receiver. From the observation device flows forward correction data past the receiver and the received message to a correcting device that sends the repaired message to its destination. This is a cumbersome solution. Even though it reduces it considerably, the additional channel required for this solution does not eliminate noise – there remains an arbitrarily small fraction of errors. Other ways of battling noise include various uses of redundancy, sending the same message many times and determining the probability of errors, understanding the redundancy at the source at the destination as well (in telegraphy, despite the clipped nature of its syntax, the redundancy of the English language remains and has to be accounted for in some manner).

19 We should not be surprised by the quantitative nature of the solutions attempted in the form of surveillance devices. However, I am arguing that the mathematical model of communication is far from value neutral or even, strictly speaking, a technical problem. It poses a cultural problem the demonstration of which is part of how it may be constructively regained. This project also requires further reengaging with failed representations of the Shannon and Weaver model.

Straw Model

20 As I have been insisting, the telegraph office is the medium to which readers of Shannon and Weaver need to turn in order to productively regain their work. Unfortunately, the era of telegrams is over with the elimination of the service by Western Union in January 2006 after 155 years in the business. The transit from telegraphy to telematics is complete. But was the situation in the late 1940s any more promising for telegraphy?

21 By looking at how the Shannon and Weaver model appears in work of Marshall McLuhan, singly and with his son Eric, we will find that the great thinker of media has little to observe about the message of the telegraphic medium. McLuhan's own theory of communication was articulated

against the reigning cybernetic model of the time in which the receiver was thought to merely (re)produce and 'match' what was encoded and sent, often having to turn to a supervisor to deliver the goods to their final destination. McLuhan did not appreciate the rationality of the linear mathematical model of communication. The distinction that was often made by McLuhan between 'matching' and 'making' marks out two apparently different conceptions of communication.

22 Marshall and Eric McLuhan, for instance, devoted a few pages in The Laws of Media (1988: 86ff) to a critique of the Shannon and Weaver model. They claimed the model was based on the assumption that 'communication is a kind of literal matching rather than resonant making'. To borrow the terms used by the McLuhans, the Shannon and Weaver model is figure without ground; left hemisphere (quantity, precision) over right hemisphere (holistic, simultaneous); matching over making. The model embodies efficient causality – a force that is testable and controllable, without paying proper attention to the 'side-effects' of communication, which it excludes, and in so doing misses the new ground or 'environment' that emerges and shapes the experience of users; indeed, it transforms their worlds. For the McLuhans, communication is about making and interaction ('participation'), about freedom from fixity and rigidity. Matching what arrives at the destination with what was formed at the source ignores participatory meaning-making.

23 The McLuhans consider almost any artifact to be amenable to the study of its transformative effects on users and grounds. But their construction of the receiver liberated from the 'hardware model of information theory – transportation of data from point to point' (McLuhan and McLuhan, 1988:111) – is in the service of a description of the sensory surround of the new electric environment of 'tactile acoustic space'. In other words the McLuhans announced a theory of perception that took making to mean that receivers were creative artists. Theirs was a poetics of adaptation by degrees. I want to put this in somewhat negative terms. For McLuhan (1968: 124) the failure to create an anti-environment 'leaves one in the role of automata merely'.

24 Throughout his career Marshall McLuhan sought refuge from fundamental socio-technological change in artistic strategies understood as coping mechanisms (artists create anti-environments, counter-situations or pen counterblasts that allow one to become aware of what is otherwise all but invisible, the environment presently structuring one's experience). A counterblast, McLuhan explained, 'does not attempt to erode or explode'. It calls for the creation of counter-environments 'as a means of perceiving the dominant one [environment]'. A counter-environment doesn't destroy, it 'controls' and 'creates awareness'. McLuhan clarifies that art copes with environments by creating anti-environments. It is a question for McLuhan, it is fair to say, of the survival of certain valorized artistic practices.

25 How does this bear on telegraphy? My hypothesis is that the social scene of decoding at the telegraphy table, and later at the telephone switchboard, influenced the formulation of problems and solutions in the mathematical model of communication. Yet it is by regaining the gender attributed by analogy to the theory, the operations of a hidden service environment, and properties of the medium that key criticisms, dismissals, and misconstruals may be swept away. There is in the mathematical model, contra McLuhan, making at stake. Telegraphy is a gendered technology, not simply by analogy, especially after the 1870s in the United States when women broke into what was hitherto a boy culture. Prior to this time, as one of Thomas Edison's biographers reminds us, tramp telegraphers such as the young Edison drifted from city to city in search of work and established friendships with operators down the line whose signature 'touch' of their keys was known to those sensitive enough to hear it (Israel, 1998: 22).

26 The existence of vocational knowledge is hardly news. But the issue here is that meaning was communicated between operators in addition to the content of the messages. The issue of touch signature survives today in the expressive dimensions of writing computer code. The channel itself had the capacity to turn handlers into meaning-makers by subtle encodings of an operator's body. Of course, face-to-face socializing during down periods would often take place from table to table in a given office (before the invention of the cubicle); and, of course, socializing also took place along the wires between geographically dispersed operators. The telegraphic scenes of encoding and decoding on an individual level influences the formulation of problems and solutions around specific practices. There were basically two ways to receive a message: listening to the short intervals (dots) and long intervals (dashes) between clicks and writing out the message in long

hand, or a decoding practice assisted by the registration on paper of the dots and dashes, which would then be translated and written out in longhand for the recipient. The double-scene of decoding, without or with a step of paper registration, would require the operator to translate the Morse Code and then deliver the message, the final destination being someone other than the operator (this suggests the social inequality of the position of the operator in a service economy, and Edison was fired more than a few times in the 1860s for various reasons). A certain level of secretarial proficiency is presupposed here (that is, in terms of code facility) but more important was the general knowledge that an operator could bring to fill in the inevitable gaps in the message; to this end, Edison was constantly consuming newspapers so that he could overcome the tremendous noise in the system (the down time produced by static, broken wires, obscure 'private' codes, and the rules telegraph operators introduced to ensure clean and efficient communication free of fraud and error). This meant Edison was a maker not a handler or mere matcher.

27 Yet let's be careful here because agency has slipped from the discreet girl into the fingers of an active male receiver. Senders and receivers of both genders are active in the range of communications available to them in using the code and technology, and both are subjected to the telegraphy office's chain of command. The channel of the telegraphy was filled with all sorts of noise such as fluctuating currents, leakages, but also content meaning provided by operators, etc. If we adopt the language of Edward Sapir (1949: 13) for a moment, it is evident that a 'language transfer' from speech (phonocentric 'original language system') like Morse code (beyond writing toward a remote region in Sapir's estimation) entails the principle of a reverse transfer (partially or back to the origin) that holds much potential for noise. The notion of operator discretion must also be considered in its most general rather than moralistic sense because the scene of telegraphic decoding often involved discretionary interpretation even if, in the end, this simply meant informed guesswork that faithfully reproduced the original encoded message, which could be easily confirmed in the case of news stories, but not so readily in the case of proprietary business information. The issue of privacy was present though it would intensify with further revolutions in telecommunications, beginning with the telephone. Inverse transmission in the double-scene of decoding involved supplementation of the message. From the signature touch of the key to the tone of a female operator's voice, to her familiarity with certain users/subscribers, and role in office politics, there is a remarkable play at work in the channel that relies upon relays operated by employees.

28 Matching cannot be simply contrasted, emptily and unproductively with making, as if the latter was annointed with activeness against an allegedly passive matching operation. Making the link between encoding and decoding and lives lived is the hallmark of cultural studies as it has rethought the model of communication and this insight can produce as informed reading of the mathematical model as well. One may only speak disparagingly about the 'automata' of the transportation model (poles of sender-relay-receiver) by completely eliding the constraints of the social semiotic scene of communication. The processes of subjectification that rendered young women (telegraph and then telephone operators) active (Martin, 1991: 61) nodes in the labour process also gave rise on their part to resistances and strategies of coping (personal and collective, technographic and semiotic) with discipline, standardization, exhaustion, and exploitation.

Cold Warrior

29 Warren Weaver was a consummate promoter of scientific institutionalization. His wartime activities concerned now-classic problems of machine translation in the service of intelligence, theory of air warfare, especially computing problems around antiaircraft and air-to-ground fire, as well as cryptography, all undertaken within his committee, the Applied Mathematics Panel, under the auspices of Dr. Vannevar Bush's Office of Scientific Research and Development. His public labours as a popularizer of science began prior to the war in the 1930s in his capacity as an officer of the Rockefeller Foundation. He won prizes for his popular science writing from both UNESCO and the American Association for the Advancement of Science. The promotion of R & D and proselytizing for science's wartime accomplishments are intimately linked with Weaver's name and he publicly intervened in debates around the establishment in the US in the postwar years of national funding bodies for science research when they were threatened by critics of big science.

30

Weaver's humanism could be quite misleading. For instance, he described how he deployed his notion of communicative accuracy – an audience is moved in the right direction of correct understanding without being mislead when the inaccuracies of the communication do not unduly hinder this movement – as chair of a committee of geneticists on the likely genetic effects of nuclear fallout from atomic weapons testing. The split committee (between a group warning of grave risks and another of tolerable risks) was won over, difference resolved, by Weaver's concept that put the emphasis on general agreement over specialist qualifications and public debate over what he defined as minor issues. Communication accuracy smooths dissensus by means of generalization and the diminishment of difference; it is a form of 'quietism' – removing debate from the public realm (Weaver, 1967: 183-4).

31 For all of Weaver's sophistication in promoting the needs of science and 'progress', he had at his ready a, to adopt a McLuhanism, rear-view explanation. In a more popular version of his famous essay on information theory, he turned immediately to the example of telegraphy to explain the mathematical model, using as 'content' the sending of a birthday greeting by wire (a non-commercial usage). Circa 1952, this may have seemed strange to a telephone using public; indeed, it does not seem concerned with state of the art telecommunications and information technologies (television or early computers); nor, for that matter, was he interested in technical improvements in telegraphy (automation of transmitters, increase in wire capacity, etc.). Indeed, Weaver optimistically generalizes to telephone communication from telegraphy. More importantly, he explains key concepts like the stochastic process of likely message choice by means of Morse code design, underlining probability as opposed to predictive laws:

32 > When the telegraphic code was first designed, why did Morse assign the simplest symbol of one dot to the letter E, and the most complex symbol of three dots, a space, and a dash, to the letter Z? For the very good statistical reason that he counted the supply of type in a printing office, and found that they had a maximum number (12,000, in fact) of examples of E and the minimum number (only 200) of Z (Weaver, 1967: 207).

33 Weaver has recourse to telegraphy because he wants to explain an unfamiliar thing, a mathematical theory of communication, by analogy with a familiar thing. This use of analogy was described by Max Black (1962: 231-32) in terms of how theory takes hold by analogy of something better known and established for the sake of using the resources thus acquired to advance the understanding of a relatively difficult and unknown model. This seems to be what motivated Weaver to turn to telegraphy. The intellectual respectability of extension by analogy – without metaphor there might be no algebra, quipped Black – also has drawbacks because it relies too heavily on a specific technology that 'insulates' the theory from criticism. It also permits, as we have seen in Weaver's notion that the analogy of telegraphy is generalizable to telephonic communication (not to mention, television, smoke signals, drumbeats, heliograph signals, etc.), an opportunity to avoid explanation in the name of suggestion (plausibility) and deceptive smoothness (universal translatability between disparate systems as long as approximate structural similarities appear to be maintained). This overcoding operation is facilitated by familiarity and helps extend the theory's reach through a process of naturalization of its components, reproduction of their relations, and inoculation against the introduction of new, heterogeneous elements.

34 The restoration of context – technology and its intersections with gender and socio-semiotic scenes of decoding – undertaken in this essay had the goal of unearthing some of the cultural content that has been hinted at but not fully excavated in communication theory by thinking culturally with Shannon and Weaver. In short, the general communication model proposed by Shannon and Weaver was most readily explicable in terms of a specific 19th century – a Victorian, if you like – technology. Weaver asked, then, readers to look backwards in order to grasp it.

35 I regain from Shannon and Weaver contexts both socio-semiotic and technological that transcend the model's status as a mandatory stopover' and 'founding reference', as Armand and Michèle Mattelart (1992: 44) put it, for all socio-culturally minded readers in communication studies. It is this status itself that has proved problematic because it has resulted in a certain kind of inability to tarry befalling enthusiasts and critics alike; an impatience that is evident in the abundant summaries of the model's key components, as they were graphically represented, available in literature that demonstrates the widespread desire to show the model's limitations (a linear model

adequate for only communication engineers; Mattelart, 1992: 68). My strategy is not to uncritically revalorize the mathematical theory and to point backwards the circular and feedback models that came in its wake. Likewise, I do not want to deny the negative influence of the mathematical model's legacy of presenting communication as one-directional, based on shaky behaviourist postulates (stimulus-response), and a 'totally inadequate grid to apply to the human communicational situation', as Anthony Wilden (1980: 96) stated definitively. Despite this, however, the features of a specific human communicational situation can be not inadequately applied to such a grid in a socio-semiotic decoding of the mathematical model.

36 In the end, it is simply that this model must be forced to reveal its meta-modelings in the context of its ideological underpinnings, socio-technical entanglements, and discursive strategies, exposing the extent to which 'mathematics' is suspended in complex non-mathematical interchanges the critical apprehension of which permits a reordering in which Weaver comes before Shannon.

Author's Biography

Gary Genosko is Canada Research Chair in Technoculture at Lakehead University in Thunder Bay, Canada. His recent work has focused on the intersections of administrative technology, race, and alcohol in historical context. He is currently working on 'Phreaking the Maple Leaf' – Canadian hackers, phreakers, and anti-surveillance cyborgs.

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