

The Unmeaning Machine. Cybernetics from Semiotics to AI

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This paper partly retraces the impact of cybernetics on the issue of meaning, showing 1) how cybernetics and information theory prepared the epistemic conditions for semantics-focused approaches to Artificial Intelligence (AI); and 2) that cybernetics was an opportunity also for the renewal of ideas concerning artistic experience. The latter point is explored in cybernetics' crossing with aesthetics, as it occurred in Umberto Eco. His move towards semiotics in the late 60s indicates, on one side, a dissatisfaction with information theory, at first deemed ideal to grasp post-war poetics, but also, on the other, the survival of an interest towards its concepts, so much so that Eco integrated information theory in his general semiotics. Eco's thoughts on the difference between information and meaning lead us to reflect on how the intersection of aesthetics and semiotics, occurred through cybernetics, changed the way in which we conceive of creativity in AI. This change contributes to shaping contemporary studies that simulate creativity with computational means.

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Introduction. There Once Was Meaning

L'«illumination» vient ensuite.

Breton 1933, 63

A great interest has accrued around *meaning* in Artificial Intelligence (AI). This interest met spurious results and discontinuous efforts, but there are traces that go back to its origins in cybernetics, and the latter's intersection with semantics. Even though a study of this intersection hasn't been attempted yet, we aim to show, first of all, how the issue of meaning traverses the passage from cybernetics to AI. Two recent discursive events can be mentioned to introduce the topic.

One comes from neuroscientist Erik Hoel, who in a newsletter post, "The semantic apocalypse", laments that the outputs of neural networks trained to replicate artistic styles or to create original ones are just «a "deep fake" of meaning» (Hoel 2021, online). Hoel refrains from tackling this in depth, but he lets us approach the discursive field he interacts with, formed by the enunciations on artificial creativity circulating in peer-reviewed journals, divulged in academic seminars, commented in op-eds and Quora threads. His post is a refraction of the discursive universe that it touches upon, where meaning is re-surfacing as a scientific issue. To better grasp this resurgence, our second reference reconnects the topic to cybernetics.

In 2018, the Santa Fe Institute organised a workshop on "Artificial Intelligence and the Barrier of Meaning". Academic scholars and researchers from private companies came together to discuss the semantic limit of AI. The lead organiser of the workshop, Melanie Mitchell, wrote a recapitulatory piece (Mitchell 2019) exposing the questions that were left unanswered (i.e., could meaning be linked to other forms of reasoning, like abduction?), and referring the theme back to mathematician Gian-Carlo Rota, who had first evoked the idea of a barrier of meaning in a piece written while at Los Alamos National Laboratory. Rota started to work there under the invitation of Stanislaw Ulam, a name closely associated with the Manhattan Project. It was to honour Ulam's memory that he wrote the article. In particular, he was fond of a conversation the two had while walking in Santa Fe, located not too far away from Los Alamos.

AI was booming across the US and Europe, with great progress being made in the modelling of human intelligence, but, the two friends wondered, could machines ever grasp the meaning of words? Ulam framed the issue with an image that exposes a view of semantic systems common among his peers:

Imagine that we write a dictionary of common words. [...] When you write down precise definitions of these words, you discover that what you are describing is not an object, but a function, a role that is inextricably tied to some context. Take away the context, and the meaning also disappears. (Rota 1986, 2)

The image of the dictionary implies a semantic theory postulating that, to attain the meaning of any word in a set, it is necessary to define a number of primitive elements which, if combined by certain rules, form the semantic field of a language. This phrase encapsulates how meaning

impinged on the design of machines similar to humans in semantic tasks. Ulam, Rota, and Mitchell, lay out an intergenerational line of inquiry focused on crashing the «barrier of meaning» of AI. What came before them, in terms of a semantic urge in early cybernetics, we shall now attempt to outline: the path leads to an encounter of semantics and cyberneticists, or even their reciprocal reformulation, which is precisely what occurred with Umberto Eco.

Meaning in the Machine: How Semantics Entered Cybernetics

Cybernetics and semantics cannot be tackled as if in a vacuum. We have to account for some contingencies. The development of a science of meaning and of cybernetics both occurred between or in war times, often in the US and within the walls of academic or industrial institutions, the latter often patronaged by the National Defence Research Committee, the most prominent office funding research on automatic warfare.

Many cyberneticists were involved in military research programs: Ulam and John von Neumann worked on the atomic bomb; Alan Turing worked for the UK army on decryption; Claude Shannon was employed as an engineer at Bell Labs, contributing to advanced fire-control systems. Norbert Wiener designed anti-aircraft guns, and we can at least partly attribute to his work on military craft his ideas on how autonomous behaviour might occur in machines too. [1]

With Arturo Rosenblueth and Julian Bigelow, Wiener co-authored the 1943 article on *Behaviour, Purpose and Teleology*: here, meaning is never the main topic, nor the discussion centres around communication *per se*; but the relevance of the article for us lies its implication that purposefulness can be found in organic *and* inorganic agents, their activity seen as isomorphic. The authors' behaviourism allows this interpretation, although it wasn't a matter of interpretation, but «a physiological fact» (Rosenblueth et al. 1943, 19), since nothing much differentiates machines and organisms. [2]

The war looming in the background and seeping in the research is apparent when 'purposeful active behaviour' becomes a description applicable to machines as well: «A torpedo with a target-seeking mechanism is an example. The term servomechanisms has been coined precisely to designate machines with intrinsic purposeful behaviour». (19) A torpedo seeks its target by responding to a physical stimulus, thus generating a feed-back loop between the approximating final output and the sum of all the inputs that the torpedo receives as adjustments of its behaviour, until it hits the target. The device doesn't understand the inputs, nor the destination: it responds to stimuli, but it doesn't endow them with meaning. But this machine-organism isomorphism sets the stage for a further question: how does meaning materially emerge in communication?

The issue stems from the fact that communication was conceived as a mechanical process, structured around binary combinations of inputs and outputs, along a straight line from sender to receiver. This structure relied on inquiries on how synapses and neurons function, as in the studies in mathematical biophysics by Warren McCullough and Walter Pitts,

[1] More correlations between cybernetics and military practices arise if we look at the files redacted by US army members (e.g. Bull 1958), where automation becomes an issue of military strategy.

[2] For the machine-organism opposition, we refer to the valuable text by Canguilhem (2008), a conference reprinted in the 1965 French edition of *Knowledge of Life*.

both in close contact with Wiener and working under his supervision at MIT. It was a common scientific belief that the nervous system operated through a switching mechanism, making neurons and synapses be either on or off. The analogy with how an electrical machine functions quickly took hold:

The synapse is nothing but a mechanism for determining whether a certain combination of outputs from other selected elements will or will not act as an adequate stimulus for the discharge of the next element, and must have its precise analogue in the computing machine. (Wiener 1961, 14)

To reinforce the analogy came the notion of *information*, which had gained relevance thanks to the field of telecommunications: the urge was to translate the exchange of meaning among humans – tied to mental activity, and thus having a qualitative nature – into a quantitative measure regardless of the physical medium. We won't delve into the intricate history of communication engineering, but it will be useful to evidence a few steps taken toward this quantitative translation.

Once again, the history of knowledge borders the one of institutions. In 1928 Ralph Hartley, an engineer employed at Bell Labs, penned an article on the *Transmission of Information*, arguing that automatic devices could perform the functions (reception, selection, encoding, decoding, noise cancelling, etc.) that make up the production and circulation of symbols among humans.

While proposing that frequency-range could be a general measure for information, to uniformly describe all communication by the same unit, Hartley raised a significant issue for information theory: if two human operators can understand each other when they talk or write, it is because they share a *code*, allowing them to interpret the symbols in the same manner, giving them the same meaning. But meaning is a psychological factor, which has to be eliminated if we want to «set up a definite quantitative measure of information based on physical considerations alone» (Hartley 1928, 538).

It was preferable that the semantic-psychological and mechanical-physical levels stayed distinct: the sending and receiving of symbols, the information transmitted by such symbols, had to be understood as physical processes, thus granting an adequate abstraction from psychological bias. Coding, and the associated selective action on the symbols used in communication, are then transformed into a physical problem, related not to the semantic interpretation of symbols, but to the probability that other symbols might have been selected. The notion of information becomes a measurement for the chance that a symbol is selected among other possible ones. Information as a measure of probability, coding as a grammar of the possible combinations of symbols: here information theory takes a more rigorous look at its objects and concepts; and it is here that we perceive the direction pursued by a colleague of Hartley, Shannon, the man behind the mathematical theory of communication. He took things a step further:

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently

the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. 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. (Shannon & Weaver 1964, 31)

A hierarchy of communicative aspects has been established. Warren Weaver, after Shannon, argued too that all communication is reducible to the technical level, related to the accuracy of a transmission and supervening on two other levels, which he called the semantic and the effectual – the latter seemingly akin to the pragmatic aspect that had been defined by Charles Morris, the semiotician who, at that time, was tenured at the University of Chicago together with Rudolf Carnap, fresh off the publication of his *Introduction to Semantics* (1942). The evolution of semantics was proceeding on a steady parallel line with cybernetics. [3]

The ties float on the surface of textual compresence: they are retraceable through documented institutional relations, shared themes that appear across different texts, direct interactions between key individuals or between groups, the discourses of one and the other side intersecting and belonging to adjacent fields of knowledge. Most of all, cybernetics and semantics coexisted in the same epistemic transition. Human expression was being modified by a tide of technical innovation. The mechanics of communication were becoming more important than the semantics of communication; hence the views of Shannon, Weaver, and before them Hartley: the engineering aspect is, not just of higher relevance, but what determines the existence of any semantics. So, following what we said earlier, if a message is said to convey information, then that information doesn't stand for what the message *does* say, but what that message *could* say.

A probabilistic theory of communication, where a message is made of a series of symbols selected by a sender and decoded by a receiver, without the need to consider (which doesn't mean to deny, but certainly to ignore) any signifying relation between the symbols; a theory where the information conveyed equals «the logarithm of the number of available choices» (Shannon & Weaver 1964, 9); and lastly, a theory where the generation of any message depends on «the special case of a stochastic process in which the probabilities depend on the previous event» (11), that is, on a model called “Markov chain”. In every communicative sequence, the appearance of a symbol is determined by the ones selected before; therefore, information conveyed by each symbol is measured on the probability of what could have been chosen instead to continue that same sequence. It implies that, if there are more choices that could have been selected, then the message conveys more information, like with those messages where more than one option in decoding them yields the same probability.

The main advantage of this theory, according to its advocates, is its generality, due to the fact that it can be applied to a vast range of communication processes, both from organic or machinic sources, and in diverse fields from cryptography to translation – although, as Weaver admitted concerning the latter, «the complete story here clearly requires

[3] We couldn't here provide a full examination of other works on meaning, like those conducted by Ogden and Richards, Walpole, Ullman, and Ziff, among others, who in no lesser terms stirred the evolution of semantics and communication theory.

consideration of meaning, as well as of information» (25). A cybernetic theory of communication is so generalised that it is applicable to phenomena where semantics might be involved – while still being supervened by the engineering level. Moreover, Weaver adds, information theory might prove «particularly promising for semantic studies, since this theory is specifically adapted to handle one of the most significant but difficult aspects of meaning, namely the influence of context» (28).

We have gone full circle to Ulam's consideration: to grasp meaning one has first to understand how it is generated within a context. A model of information transmission based on Markov chains accounts for the co-influential events of any communication. This is why, if the power of a scientific theory is guaranteed by its degree of generality, cybernetics tilted more and more towards research on human-like semantic behaviour (translation, man-to-machine interface, or in general natural language processing). We witness here a branching of cybernetics into three paths.

The first is the closest to the original scope of cybernetics: to analyse and define the principles of complex systems using an abstract model of communication. William R. Ashby's work exemplifies this view, where any message is reduced to its behavioural and functional explication. This gets more evident once we approach the definition of what is a machine: «a system whose behaviour is sufficiently law-abiding or repetitive for us to be able to make some prediction about what it will do» (Ashby 1958, 225) Again, the problem is how *selection* occurs and how it can be measured. If, then, we tackle the question of building a machine, we are not dealing with «the more obvious process of shaping and assembling pieces of matter, but with the less obvious questions of what *determines* the final model, of how it comes to be *selected*» (252). This is one of the clearest formulations of the hypothesis that a machine might seem human-like. Ashby asks, «How can a machine select?» (260). A machine might select the state to be in by following a straight trajectory of possibilities; no variables, no alternative paths. A machine could reduce the variety in the pool of possible states it can be in, showing selective behaviour by reduction. Similar mechanisms in selecting and reducing, others that amplify, regulate, control, don't need meaning: the actions emerge out of stochastic processes. But it doesn't entail that machines aren't intelligent: in fact, if a machine «were to show high power of appropriate selection [...] we could hardly deny that it was showing the *behavioural* equivalent of "high intelligence"» (272). It proves useful to maintain this reductionist side of cybernetics in mind, as some of its tenets (i.e., the mechanical reproduction of intelligence) are not too far away from what the other branches formed after the 50s were proposing in their turn.

Thus, on one hand, and running along the second avenue of cybernetics, we find a new approach in the respective works on semantic processing in automatic machines by Ross Quillian and David MacKay: their goal was to reintroduce the psychological factor in order to reach a more complete simulation of human mental activity, which included the design of semantic models. We won't insist further on their contribution as we shall come back to them, especially to Quillian, in the chapter dedicated to Eco. Then, on the third avenue of cybernetics, we have AI, where the computer programs built «are usually called "heuristic programs"» (Minsky 1968, 8), because they were aimed at simulating and enhancing

problem-solving capabilities. In both avenues we notice a tendency to focus on knowledge representation as a core issue. The premise was that, if a general-purpose AI had to be achieved, the semantic aspect, once deemed secondary, became the most important one to reproduce artificially. AI and adjacent approaches started to focus more and more on translation, speech, on the replication of literary writing, painting, musical composition, testing what of human creativity could be simulated through algorithms. [4]

If more complex tasks had to be solved by relying on computational methods, if even artistic expression could be reproduced, it was clear that meaning was leading cybernetics towards creativity; and, moreover, the proximity of the two legitimised the appropriation of cybernetic concepts by fields of research that viewed them as a new approach to human communication. Starting from the 1950s, the gaze of many scholars in the humanities turned to cybernetics. One of these was Umberto Eco: similar to what Ulam argued regarding meaning, what matters is to retrace a context.

[4] McCarthy et al. (1955), the originators of the first project on AI, proposed that seven paths of research needed to be explored, the last one being *randomness and creativity*, suggesting that the issue of creative behaviour had already grown into a fully formed scientific inquiry.

Open Automata: How Cybernetics Entered Semantics

As we saw in the previous section, the engineering model of communication tended to exclude, or at least leave largely unquestioned, what meaning is and how it works. However, the Shannon-Weaver model (sender, encoder, channel, decoder, receiver) started being implemented in fields of research where meaning would be expected to be ineliminable. Structural linguistics, which was spearheaded by Roman Jakobson, and anthropology, with Claude Lévi-Strauss as its beacon, were some of the most receptive disciplines when it came to information theory. For example, apart from the overall model, the ‘message’ and the ‘code’ of which Shannon spoke, key elements of any communicative situation, were acquired as new linguistic concepts: «According to Jakobson’s theory, speakers consulted the codes at their disposal and composed a message according to its rules» (Geoghegan 2011, 115).

This promiscuity of early structuralism and cybernetics was not only epistemic, but institutional: the aforementioned scholars, and other European expatriates, lived and worked in the US during the Second World War and the Cold War. The Fifties saw an increase in institutional relations across Western countries, often driven by Jakobson, Lévi-Strauss, and their colleagues; thanks to them, as well as to the international profile of some cyberneticists, like Wiener, information theory seeped into debates, university courses, press houses and conferences around Europe.

However, the arrival of these theories was untimely and, ultimately, their effects on mass communication studies was not always as enduring as their proponents hoped. The CECMAS (Centre d’études de communication de masse, today Centre Edgar-Morin), one of the first attempts in France at the intersection of mass communication studies and information theory, was founded only in 1960, when several programs in the US and also abroad to fund cybernetic-influenced fields were already being shut down or not even begun. Two reasons often quoted are the rise of generative grammar with Chomsky and the shift in the scientific

community gathering around AI, which was more and more attracted to semantic issues, going beyond Shannon.

It should be noted that the move towards or against cybernetics in the '60s, when the field seemed at its peak, wasn't symmetrical. It certainly wasn't among the scholars that were beginning to name their research as semiological. Though Roland Barthes was one the directors of the CECMAS, his interest in information theory had always had a taste of scepticism, especially regarding the aim of a neutral scientific language. He had employed Jakobson's revisited Shannon-Weaver model in *Elements of semiology* (1964) and before that in *Le message photographique* (1961) – echoed years later by Claude Bremond's *Le message narratif* (1964) –, but it didn't escape him that notions like message, or code, had emerged from a specific milieu, the American engineering one, with a specific goal in mind, to make communication more efficient by technical means: «As he deployed the tropes of cybernetics and information theory, he also submitted their procedures to ideological and historical critique» (Geoghegan 2020, 67). Meanwhile, A. J. Greimas, a proponent of structuralist semantics, advised to borrow with caution

from disciplines parallel to linguistics, such as information theory, which treat only data dealing with a signifier transcoded from a natural language and, because of that, make problems of signification parenthetical. (Greimas 1983, 33)

In Italy, as we anticipated, one of the first scholars to employ information theory in the human sciences was Umberto Eco. His thought was grounded in aesthetics, since at least his dissertation on the aesthetic problem in St. Thomas Aquinas, up until the publication of *Opera aperta* (OA) in 1962, but it was gradually influenced by Claude Lévi-Strauss, the Russian formalists, Roman Jakobson – the three shocks of 1963, as he called them prefacing the 1992 edition of OA [5] –, but the greatest imprint, since the 1973 publication of *Il Segno*, distancing himself from structuralism, was borne by the semiotics of Charles Sanders Peirce.

[5] References are to the Italian editions of OA, providing the translation in a bracketed text after the quote. Printed translations of the originals will be used when possible.

It seems relevant to notice that Eco *could not* have met cybernetics and information theory through what was going on in France; at least not through the readings of the structuralists, like Jakobson and Lévi-Strauss, who had become familiar to him only since 1963. What about before that? He had read Wiener and Shannon in English, but there is a different, larger context of reception that must be accounted for.

Two movements need to be retraced: one from aesthetics to cybernetics, the other from cybernetics to semiotics. Following them, and considering their respective frames of reference, we focus on Eco's intellectual growth, dealing with his early aesthetics, which prepared his proposal for general semiotics. Even if non-exhaustive as an example of his time, insisting on Eco and cybernetics allows us to remark on post-war Italian culture, on the artistic and philosophical situation, when the latter often sought intakes from outside to invigorate its rampant anti-idealism. And it is also to oppose idealistic aesthetics that Eco got involved in the first place with cybernetics.

Eco seems to have viewed cybernetics as a toolbox of concepts that he could use to analyse the artistic situation: he noticed a shift in *poetics*,

a term already revisited and used by Luciano Anceschi, at least since his *Saggi di poetica e di poesia* (1942). Anceschi was a prominent figure in post-war aesthetics and a *deus ex machina* for the birth of the Gruppo 63, to which Eco associated himself, contributing greatly to the history of the neo-avant-garde, to the point that *OA* became a flagship theoretical text for that group of intellectuals. Poetics – that is, as Eco says introducing the 1967 edition of *OA*, «il programma operativo che a volta a volta l'artista si propone, il progetto di opera a farsi quale l'artista esplicitamente o implicitamente lo intende» [6] – had to become the main target of aesthetics. Contrary to Benedetto Croce's successors', what is encouraged is a tendency to study the procedure more than the artists, the creative products and the operations that were followed more than a personal psychology; a tendency, which is really an aesthetic posture, towards art as a fact of culture, to be studied with no prior prejudice regarding its supposed value or its true belonging to the artistic realm, thus obscuring all forms of personal judgement from criticism: according to Eco, an art critic is also a cultural critic, their descriptive method needs to attain such a generality, not neutrality however, that all human forms of expression can be analysed.

[6] «The operative program that step-by-step the artist prepares for himself, the project of a work in progress as the artist explicitly or implicitly intends it» (Eco 1962/2016, 18, *author's trans.*).

This descriptivism was presented by Eco as a path towards structural analysis, in a light that partly reflects his exposure to the structuralism burgeoning across the Alps; however, Eco's method resembles, more directly than his French counterparts', what Shannon and Weaver were trying to achieve with information theory, that is, looking to formulate a general behaviourist model to compare all communication regardless of the medium.

It has been observed, for instance by Rocco Monti (2021), and Eco himself admitted, that his method hinged on an *aesthetics of vagueness*: like in cybernetics, vagueness, or ambiguity, is a quality of a message related to its information. Here, the difference lies in the fact that, whereas ambiguity was considered detrimental in information theory (an ambiguous message is less decipherable), avant-garde poetics, and most works of art, seemed instead to favour it. In the same introduction quoted earlier, detailing the background to his aesthetic proposal, Eco says that:

l'opera d'arte è un messaggio fondamentalmente ambiguo, una pluralità di significati che convivono in un solo significante. [...] tale ambiguità diventa – nelle poetiche contemporanee – una delle finalità esplicite dell'opera, un valore da realizzare a preferenza di altri, secondo modalità per caratterizzare le quali ci è parso opportuno impiegare strumenti fornitici dalla teoria dell'informazione. [7]

Intentional vagueness as a general creative ethos, succinctly encapsulated by what Eco termed the *poetics of openness*. Hence the use of information as a term to describe contemporary art (James Joyce, dodecaphonic music, abstract or informal art), where indeterminacy had become a chief creative aspiration, noting structural similarities with transformations occurring, for instance, in physics after quantum theory. A new method focusing on the information borne by a work of art was required, more than criticism

[7] «The work of art is a fundamentally ambiguous message, a plurality of meanings that live in one signifier. [...] this ambiguity becomes – in contemporary poetics – one the explicit aims of the work, a value to realise above others, according to modalities to characterise which we deemed appropriate to employ the tools supplied by information theory» (Eco 1962/2016, 16, *author's trans.*).

seeking to establish the validity, or essence, of art, since art itself seemed to focus more on *probability* than actuality: more on what a text *might* say, than on what it *does* say.

However, another thing should catch the eye in the quote: the semi-otic terminology. This is the post-1963 OA, the one partly rewritten after Jakobson, Lévi-Strauss and the Russian formalists; however, Eco doesn't substitute the notions of information theory with those of structuralism: it might not come as a surprise that the shift to semiotics occurs through cybernetics. In fact, it was in Italian cybernetic circles located in Milan and Turin that the semiotic theories coming from across the ocean started to circulate, already since the 40s, and 'meaning' was a central point of discussion. There is in fact an overlap between what those cyberneticists were discussing, and the receptivity to foreign stimuli of Italian philosophy. [8]

These circles revolved around several research centres and journals, one of which was *Methodos*, launched in 1949 by Silvio Ceccato, Vittorio Somenzi and Giuseppe Vaccarino, one of the earliest Italian journals to publish articles on information theory and, in parallel, on Morris' theory of sign behaviour. Morris was well received, since it seemed to fit cybernetics' attempt to design models for communicative behaviour. His idea of meaning was greatly discussed, both in the *Methodos* circle – by Ceccato himself or by Ferruccio Rossi-Landi, another semiotician who was among the first to set the stage in Italy for semiotics to gain the intakes of cybernetic and aesthetic theories –, and by Eco and other semioticians, like Emilio Garroni.

This is Ceccato in 1949: «Una adesione generale è data ai risultati di Charles Morris. [...] il linguaggio diviene comportamento». [9] Insofar as it is described as a behaviour, language becomes the object of cybernetic description. Thus, it might be automatically reproduced by a machine: all it takes is to take any complex system of expression as a system of probabilities. But this doesn't entail a disappearance of meaning, as much as it entails a reconsideration of this concept within a theory of general communication. After all, even Morris himself wasn't entirely sure about what to do with 'meaning': «What of the term 'meaning'? [...] In general it is well to avoid this term in discussion of signs; theoretically, it can be dispensed with entirely and should not be incorporated into the language of semiotics» (Morris 1938, 43), and were it to be used, it had to be defined not as a thing in the world, but as an element of semiosis. It was then on these grounds that Garroni criticised Eco's use of the information-meaning opposition. Let's recall Eco's words first.

Eco gathered from his reading of Wiener that information had to be understood as an *additive* property of communication: there can be more of it or less of it. Information either grows or disperses, and it is tied to the originality conveyed by a message. Thus, information might be thought as what provokes surprise when a message contains something deemed improbable. If a language is a system of prefixed probabilities, and thus a *code of communication* (Eco 2016, 106), then a creative speaker is the one who can scan this system to find the less probable combinations, the less predictable ones. What is predictable, thus, yields less

[8] It isn't a chance, then, that the printed copy that we consulted of Abraham Moles' book on aesthetics and information theory, published in 1958, read on the first page: "Dono del Prof. Pareyson", gifted by Pareyson, professor of aesthetics at the University of Turin and Eco's mentor.

[9] «A general support is given to the results of Charles Morris. [...] language becomes behaviour» (Ceccato 1949, 235, author's trans.).

information. However, it doesn't necessarily yield less meaning. Actually, Eco says, usually the most probable messages are also the most signifying: they are more easily linked to the pre-constructed knowledge of a fact, they are more expected, thus they make more sense (shaping our expectations in a given context). It is true that the usual response, when faced with a message that we cannot comprehend, that surprises us, that yields more information than we can take, is 'this doesn't make any sense!' Art that plays on this sense of indeterminacy is art that plays on the level of information: art that plays with regular or irregular patterns, with our expectations, since it is supposed that we participate in the same communicative code as the artist. Reasoning, much like in cybernetics' theory of intelligence, takes the form of induction, which, if automatized, might lead to machines that perform like humans in prediction games, or in the composition of artistically valuable works. This is true if we take information as a measure of value. Was Eco, similarly to Shannon, proposing that the technical level of communication, tied to information, supervenes in artistic creation too? Not entirely, but some criticism of his contemporaries tackled this aspect: Garroni was specifically willing to test the validity of Eco's application of information theory to aesthetics.

After having reviewed the cybernetic literature that Eco referred to in *OA*, Garroni concludes that informativity and semanticity – respectively, the property of a message of carrying a quantity of information to someone capable of decoding it; the property of a message of signifying something to someone – are in no substantial way different in cybernetics. He concedes that Eco acknowledges it in *OA*, but then he adds that information theory, far from dispensing with meaning, actually tried to rescue it, by reintegrating it within a mathematical theory of communication. Garroni's criticism becomes a provocation towards cybernetics and Eco centred on the identity-difference of information and meaning, and particularly on an issue common to both: *selection*. Garroni asks:

Chi, per esempio, opera la scelta? Il fruitore? Ed ecco verificarsi la curiosa circostanza per cui il selezionatore-trasmittente coinciderebbe con lo stesso ricevente, e la comunicazione si effettuerebbe nell'ambito della stessa persona, con paradossale esclusione dell'autore (il quale programma, ma non comunica propriamente). [10]

[10] «Who, for instance, operates the choice? The user? Hence the curious circumstance where the selector-transmitter coincides with the receiver, and communication is carried out within the same person, with the paradoxical exclusion of the author (who programs, but doesn't really communicate)» (Garroni 1964, 258, *author's trans.*).

Garroni's criticism led Eco to reformulate his theory, moving away from poetics and towards semantics as a new way to tackle the analysis of how knowledge is structured in a culture and how it can be described.

If sender and receiver aren't distinguishable in cybernetics, the concepts imported from it had to be revisited, if not elided, since they led to an impasse: who interprets? Who endows a piece of information with meaning? Interpretation, the once eliminated psychological bias, had to be reinstated in the model inherited from cybernetics.

Eco delineates his reply to Garroni in an addendum dated 1966 which was included in the second edition of *OA*. First, Eco proposes to delimitate what information refers to: the definition remains the

one borrowed from cybernetics, but its descriptive power is reduced in scope. What does it entail to transmit a message? It implies «la selezione di alcune informazioni, e dunque una organizzazione, e quindi un “significato”». [11]

[11] «The selection of some information and its organisation into a signifying complex» (Eco 1962/2016, 126; trans. in Eco 1989, 66).

Cybernetics is downsized, as organic and mechanic systems aren't behaviourally analogous. It doesn't concern only the emergence of meaning from the organisation of content: it would later come to Eco that the solution lies in, first, a reconsideration of the system of semantic relations (the code cannot be structured like a dictionary, more on that later), and, secondly, a revaluation of the semiotic processes involved in the production and in the interpretation of cultural artefacts. This shift was already in nuce in the passage where Eco differentiates between humans and machines: «se il ricettore dell'informazione è una macchina [...] il messaggio o possiede un significato univoco, o si identifica al rumore», [12] whereas «quando trasmetto sul piano umano, scattano [...] fenomeni di “connotazione”». [13]

[12] «If the receiver of the information is a machine [...] either the message has a univocal meaning, or it is automatically identified with noise» (126; trans. in 66).

[13] «In a transmission of messages between people, where every given signal [...] is charged with connotation» (126; trans. in 66).

Semiosis does not occur in machines. Therefore, human communication is made of connotative associations, it is a motion from order to disorder, from transparency to hermeticism; machines, on the contrary, operate in full compliance with a determinate code, following a regular and univocal pattern: they are incapable of understanding, as they are of betraying; they cannot go beyond induction and simulate the inferential process of abduction.

Cybernetics is thus confined within new logical and epistemic walls:

Una volta che i segnali sono ricevuti da un essere umano, la teoria dell'informazione non ha più nulla da dire e lascia il posto a una semiologia e a una semantica, poiché si entra nell'universo del significato. [14]

[14] «Once the signals are received by a human being, information theory has nothing else to add and gives way to either semiology or semantics, since the question henceforth becomes one of signification» (127-128; trans. in 67).

But information theory isn't entirely rebutted. As it was clear from the structuralist works of Jakobson and Lévi-Strauss, and from those of Max Bense or Abraham Moles, with their information theory-infused aesthetics, cybernetic thought could be applied to other fields of knowledge, provided that its concepts were revised; which was what Eco attempted in his *general semiotics*.

The first move forward is introduced with the distinction between source and code information. The former is a statistical property related to a source and its freedom of choice when composing a message; but, when a message is encoded and decoded, the layer of the code has to be accounted, which adds, with its interpretative and selective criteria, a further system of probability. The concepts are the same – message, code –, but Eco is using them to mark a shift in his approach, with a starker focus on decoding rather than encoding processes; and to decode, according to Eco, necessarily entails to enter a process of signification. The machine works with signals; humans work instead with signs: «il segnale non è più una serie di unità discrete computabili in bit di informazione,

bensì una forma significativa che il destinatario umano dovrà riempire di significato». [15]

Thus, the semantic aspect couldn't be thought anymore as subject to the engineering conditions of a communicative system; a stochastic model couldn't alone describe nor explain the complex interrelations between these two dimensions, like Weaver himself had conceded when it came to simulate interlinguistic translation: the fact that, going from one language to another, there can still be semantic understanding, implies that meaning has to be accounted for as a primary element of translation, whether human- or machine-made, as in any process that might be defined as creative. [16]

In 1971 Eco has moved further away from the jargon, the methodologies, and some of the concepts of information theory; nonetheless, his interest in semantics still hinges on intakes from the new generations of cyberneticist. This explains his relationship to Quillian's semantic model, often referred to as the *Q model* and deemed by Eco as 'more fruitful' than others (Eco 1971, 73). Why did Quillian's model proved important to Eco?

Eco's attempts at developing a concise and general interpretative model for cultural phenomena was then coming to terms with the fact that human cultures are, not only ambiguous, but essentially contradictory: they change, they can be incoherent, opaque, multi-layered. Meaning is an unstable element. Thus, a semantic universe is not a static whole; instead, it has to be represented as a constantly fluctuant and dynamic system, where transformation is the norm and creativity the tool. Eco needed to start from the *Q model*, since he thought it was a model of *linguistic creativity* (76).

Quillian spoke of *semantic memory*, asking: «What constitutes a reasonable view of how semantic information is organised within a person's memory?» (Quillian 1968, 216). The task was to build a model where the mnemonic function of recognition could be defined in such terms that it could be reproduced by a machine, therefore allowing it to understand the meaning of certain words. What separates Quillian's model from the rest, according to Eco at least, was its reliance on associative links that interconnect the nodes of a semantic net, each node representing a word from an English dictionary. More importantly, Quillian introduces a distinction between *type* nodes – which «lead directly into a configuration of other nodes that represent the meaning of its name word» (223) – and *token* nodes, referring «indirectly to a word concept by having one special kind of associative link that points to that concept's type node» (223). There are just a few steps to take from here to Eco's own proposal of how a semantic universe should be structured.

The *type-token* dyad – which Eco employs probably deriving it directly from Peirce at this stage – opens up to issues of what rules govern these links, how the meaning-to-meaning associations are formed and transformed. Memory was to Quillian what culture was to Eco, here: a dictionary is nothing but a code, a mostly stable one; in fact, the *Q model* isn't a configuration of the semantic universe as a whole but, Eco believes, of a portion of it, with its established attractions and repulsions (Eco 1971, 76).

[15] «The signal isn't a series of discrete units computable in bits of information anymore, but a signifying form that the human receiver will have to fill with meaning» (Eco 1968, 31, author's trans.)

[16] A critical outlook on the fallacious logical foundations of computational creativity was recently expressed by Reynal (2021).

But what about contradicting meanings, what about purposeful ambiguities, what about lies and ironic statements, what about jokes? These were the examples that Eco had in mind when developing his semiotics of codes, knowing well that to play with a linguistic (or some other) code always means to mix the banal, the predictable, with all we might deem surprising and creative. Thus, the ineffable definition of meaning, constantly avoided or derided by information theorists, became the centrefold of Eco's semiotics, by rethinking, through the Q model, the concept of code and the cybernetic acts of coding and decoding messages.

No message exists nor can it be understood without a code – even though this code often lies virtual, or even though some messages might be produced just to contradict or alter it.

Conclusion. There Now is Meaning

This is but a brush of the links between cybernetics and semantics, which cannot be fully recovered without accounting for the discursive and institutional elements that form this interconnection. Now, similarly to Mitchell's article after the workshop she organised in 2018, we are left with the unanswered questions: Morris's role in bridging semiotics and information theory deserves more attention than what we managed to allow it; Italy's history of cybernetics remains fuzzy; what artistic paths were altered by their encounter with cybernetic theories; how was the contemporary field of AI touched by all of this, especially when it comes to those studies that attempt to build automata capable to replicate human creative abilities. Can we, without a doubt, state that meaning is, nowadays more than yesterday, a central issue for AI research? If we enlarge the scope to recent advancements in machine and deep learning, to their new ways of framing and reproducing semantic processes through computers, we cannot but notice that the study of the barrier of meaning and its history from cybernetics to AI certainly needs more refinement.

We also understand that we probably haven't answered with sufficient clarity some relevant theoretical issues that information theory raises for semantics and semiotics. Alas, incompleteness gives but a hope for further inquiry and critique, somewhere else and by someone else.

Like cybernetics in its time, now the field of AI cannot avoid tackling the barrier of meaning. Whether it will crash, it depends on how oblique its gaze will get, devoted to the oblique moments in the creation of meaning, like when we produce an analogy or make an abduction, when meaning escapes convention and codification.

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