Metaphors in Theory of Information. Why They Capture Our Concepts and Undertakings

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Abstract. Metaphors are common in various types of discourse; even natural sciences are engaged with the figurative way of expression mostly characteristic of the humanities. They are also suited, to an astonishing extent, to the exact, strict and formal theories of information, as has been presented in the first part of the paper, on the example of the Shannon & Weaver's Mathematical Theory of Communication. The metaphoric entanglement of the information category shows that its commonsensical and figurative conceptualization is unavoidable. Nevertheless, it also opens certain crucial questions concerning the ways of conceptualizing the probable, uncertain events which happen in the course of communication and deciding.

1 COGNITIVE TOOL

Metaphors are both linguistic and rhetoric means for making analogies between different domains of things. They facilitate the understanding of a complex, obscure, or unfamiliar domain of things, processes, and events through reference to another – one that is more concrete, familiar and comprehensible. Metaphors traditionally function as verbal expressions and utterances of particularly suggestive and pervasive power. They mainly operate as linguistic tools useful in conceiving and describing the world not only in literature but also in science, where they have been manifest and useful throughout the history of science.

But metaphors are not merely verbal in their nature, they are not limited to engaging only the linguistic or communicative competences and faculties of their users. They express deep and complex human mental states and ways of thinking, which are the crucial backdrop for these figurative expressions. Specifically, the nature of metaphors is *conceptual* rather than exclusively verbal - as it is commonly but misleadingly conceived and as is widely investigated and advocated in the theories of *cognitive metaphor* (see [1, 4, 5, 6, 7]). By comparing two different things, processes or events (the subject domains – source and target) with regard to one important aspect, i.e. saying that X *is* (is *like*) Y, metaphor helps to perceive, imagine, and understand one thing (target) in terms of another

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(source). Although it is expressed in an expressive, concise way, it is in fact a product of *image schemas* (*conceptual* frameworks) underlying said verbal expression. The frameworks which constitute the agent's mind are sensory-motor in their nature, encompassing such abstract and universal elements as: (1) time and space correlations, (2) before-after things sequences, (3) top-down and/or bottom-up directions, (4) horizontal and/or vertical orientations, as well as the agent's (5) behavioral patterns of movement, manipulation and control. These frameworks organize the agent's experience, be it of his/her immediate environment or the furthest expanses of the universe. Notably, image schemas are especially helpful in trying to envisage the possible, probable or entirely random situations, when planning and predicting the agent's future activities becomes crucial. This has important consequences both in terms of mental and practical aspects of metaphoric discourse. As metaphors shape and guide the agent's behavior in specific directions, they not only explain (as one can obviously expect) that which is is metaphorically expressed, but also unexpectedly hide or obscure is the actual content of the metaphoric thinking. "[A] metaphorical concept can keep us from focusing on other aspects of the concept that are inconsistent with that metaphor" [2]. These somewhat paradoxical consequences will be more closely examined when we consider the metaphoric nature of probable states (Section 3).

2 METAPHORS OF INFORMATION

Claude Shannon and Warren Weaver's Mathematical Theory of Communication [8] is an example of metaphoric thinking engaged in the abstract domain of communication. The linguistic aspect merely implicitly accompanies that which is explicitly (formally, quantitatively) stated. The authors admit using the word *communication* in "a very broad sense to include all of the procedures by which one mind affects another", or as they later specify, "in fact all human behavior (…) one which would include the procedures by means of which one mechanism (…) affects another mechanism" [8]. It is a very broad and general depiction of communication. The examples of communicational mechanisms include not only oral and written speech but also music, theater, pictorial art,

television, and ballet as well as a guided missile weapons system; all of the above employ procedures of sending, transmitting and processing signals that change the states of the communication processes. However "the language of this memorandum," as Shannon and Weaver relate to their paper, "will often appear to refer to the special, but still broad and important, field of the communication of speech" [8] whereby it aspires to account for all of the above examples of communication. The authors' intention has had certain consequences affecting both their own and other researchers' understanding of information.

The subject of communication as such is considered at three levels: (1) technical – consisting in matching specific signals and symbols while transmitting them during the communication process; (2) semantic – consisting in finding "how precisely do the transmitted symbols convey the desired meaning?"; and (3) pragmatic – "how effectively does the received meaning affect conduct in the desired way?". The last two levels are crucial in that they concern *changes* which communication may bring about, namely, "the success with which the meaning conveyed to the receiver leads to the desired conduct on his part". The essence of communication, including the transfer of signals, lies in changes experienced by the agents involved; information is a function of these changes. The meaning of those signals, analyzed at the semantic and pragmatic levels, is not their main characteristics. It is a relative feature of the transmitted signals and depends on particular sender/receiver intentions. But it is only in ordinary thinking that meaning is identified with information and a particular message having a content. From the point of view of mathematical theory of communication the above statement is misleading. "In particular," say the authors, "*information* must not be confused with meaning" [8]. Two messages – one of which is meaningful and the other completely nonsense – can be formally equivalent and regarded as carrying the same amount of information, no matter the things and situations they refer to.

By adopting the cognitive theory of metaphor as the theoretical background, it is possible to identify in the authors' paper certain crucial elements constituting the structure of each conceptual metaphor. Firstly, there is the *target domain* consisting of the following elements: (1) probable states of events which constitute signals (called "source"); (2) an abstract place/space where signals are transmitted ("channel"); (3) random disturbances of signals as well as interferences between the same and other elements of the channel ("noise"); (4) a way in which signals are organized into a message ("code"); (5) an effective (despite entropy) way of transmitting signals ("redundancy"); and finally, (6) transmission of signals with minimal dispersion to prevent loss of information.

To explain what the above abstract elements (characteristics of any communication) are, Shannon and Weaver provide many *analogies* with empirical and concrete phenomena and situations derived from instances of human communication. They compose a "story" explaining in detail what the subject matter of their paper/report is. In doing so, they constitute a *source domain* consisting of the following, plainly described, consecutive elements: (1) physical signals constituting the message (the news); (2) voice, writing, signals of the nervous system, all of which are constituents of the medium in which transmission takes place; (3) audible sounds or visible seen (e.g. in analog telephony or television) which disturb the

process of communication; (4) language and alphabetic coding ; (5) linguistic and literary styles which help to organize a system of signs into a message; and finally, (6) the actual act of communication. By using self-explanatory and simple analogies to everyday events and situations, the authors try to grasp the essence of information. They do it in a metaphorical – indirect rather than strict or formal – way, which helps them to home in on the general nature of information. But metaphoric understanding of information is neither exclusive nor even dominant over the formal conception of the same. It takes place, so to speak, spontaneously, in accord with ordinary language rules; it shapes the theory in a specific way, leaving on it a remarkable mark. Summarizing their theory of information/communication, Shannon and Weaver write in a tellingly metaphoric way: "An engineering communication theory is just like a very proper an 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" [8]. They suggest, in other words, that their conception of information has universal meaning what they express nevertheless through the metaphoric words. Presenting information in this phrase as merely a physical thing (telegram coming to desk) by analogy to the *meaning* of message which is always a concrete thing (which they recommend rather to separate from information as such), they unintentionally but inevitably deprive it of its abstract sense, which depends on *probabilistic* nature of information. In that way mathematical theory of communication due to its metaphoric confinement has been involved in methodological situation. The empirical and vivid elements from the source domain affected, if not dominated, characteristics of the target domain

The mentioned metaphorical aspect of the information theory, generally speaking, stems from the model of a communication act in which the speaker puts ideas (as objects) into words (as containers) and sends them (along a conduit, in a channel) to the listener, who then takes the idea/object out of the words/containers, performing all these activities automatically and without difficulty. This simplified model – to which Michael Reddy refers to as the "conduit metaphor" [6] – is very suggestive and effective in explaining both interpersonal and mass communication. We come across its realizations in ordinary thinking as well as in different conceptions and theories attempting to define communication as such. Mathematical theory of communication is partially tailored to the idea which it reciprocally reinforces. The conduit metaphor generally suggests that communication is reasonable, almost effortless, and does not bring about any interpretational problems. But Reddy argues that this reduced and simplified model fails to represent the actual complexity and richness of human communication; it is presumed that only simple examples of transmissions in mass communication can be reduced to the same. Human communication depends on changing the interlocutors' states of mind but not transmitting the thoughts alongside ideal channel. It occurs and takes place in human minds and acts, rather than in language alone. As it is never perfect, aberrations and disturbances are unavoidable, they are not obstacles but rather circumstances of its development and progress. "They are tendencies inherent in the system, which can only be counteracted by continuous effort and by large amounts of verbal interaction" [6]. The real and rich (informative)

model of such communication must consider dynamic changes rather than static and one-way mechanisms.

3 CHOICE OF PROBABLE STATES

How does the metaphoric confinement of information change our understanding of this category? To what extent does it reveal, or obscure, the essence of the same? Shannon and Weaver seem to be aware of all of these problems and consequences, however, they are not overly focused on the figurative aspect of their discourse. Their main proposition is a purely objective, not subjective (i.e. not agent-oriented), conception of communication and communication. Their basic thesis holds that information is *selection* and *choice* made among the probable states caused and demanded by communication. Transmission of signals involves selecting from a set of alternative states at the source and announcing it at the destination. It concerns not so much what really happens (the fact) as what would happen (possibility) during communicating. "[T]his word information in communication theory relates not so much to what you *do* say, as what you *could* say. That is, information is a measure of one's freedom of choice when one selects a message" [8]. During the process of communication, no messages are simply sent, instead signals are chosen, transmitted and selected. Communicating *per se* is altering both the initial and final states of this process, the result of which yields information. It is therefore in line neither with the common (intuitive) understanding of communication, nor with the model of information as the message. The natural conceptual schemas – linear, before-after sequences of things, as well as time-after sequences of events – underlying the mathematical theory of communication are used by their authors unconsciously. The metaphorical effect is caused without any prior intention.

As they mention that "the unit information indicating that in this situation [i.e. transmitting the signals] one has an amount of freedom of choice, in selecting a message" [6], Shannon and Weaver concentrate on the formal nature of the key concept. Grasping its complex, partially counter-intuitive nature demands a specific cognitive ability. They hold that the abstract "amount of freedom of choice" appeals to any type of communication when the agent's choice – no matter who or what it is, a human being or a machine – results in receiving information. To be more specific and understandable, they turn to figurative modes of expression, which ultimately makes the quantitative problem rather complicated, open to metaphoric discourse. Mathematical (probable) interpretation of information conceives it as an act of choice between possibilities with which the agent is confronted. The agent should distinguish among all probable things, events and processes and then act effectively by selecting one of the same. There is no information without choice, if the agent had no choice at all, information would not appear. Selection and choice among the possible states result increased *uncertainty,* which formally characterizes this situation. "Information is, we must steadily remember, a measure of one's freedom of choice, and hence the greater the information, the greater is the uncertainty that the message actually selected is some particular one. Thus greater freedom of choice, greater uncertainty, greater information go hand in hand" [8]. The authors explain that in order not to fall into "the semantic trap" (when one should remember that the word "information" is used in a special, narrowed meaning), one

ought to conceive information as the concept which "measures freedom of choice and hence uncertainty as to what choice has been made".

4 DECISION MAKING

Coping with the probable states of things and situations is a complex task, both cognitively and practically. It demands proper, prior comprehension of what is probability as such and then a subsequent realization of some general intuitions as well as elementary rules. The ambiguous, somehow counter-intuitive (qualitative) and at the same time exact and strict (quantitative) nature of the *concept* of probability is a challenging issue of science and common experience alike. Its scientific and commonsensical meanings are different in some regards and convergent in others. They are all in principle connected with an act of *making decisions* – a situation in which the agent pursues one direction and steers clear of others on the basis of signals/information he or she receives. For this reason, decision making is a communicational act with an informational aspect; on the other hand, any communication is at the same time intrinsically burdened with choice and decision making.

The decision-making mechanism engaged in communication is commonly compared to tossing up (flipping a coin) or betting on randomized games. This evident metaphorical aspect of conceiving what making a choice/decision when faced with a number of probable states is, brings about certain serious interpretational difficulties. Namely, it demands selecting and choosing the proper picture or model from among all the available alternatives (each with its own metaphorical power) of such a situation. And then the chosen model moulds the comprehension of the nature of probability. In such a situation people perceive and define all types of decision making as concrete games such as dice, roulette wheels or other gambling devices, and also in receiving the news – unexpected and astonishing. Empirical examples derived from everyday life dominate people's imagination and understanding of the choices they are obliged to make. At such times, the probability of scientifically-investigated events (e.g. statistics) is important and decisive.

But the very concept of probability has, in principle, two different meanings – statistical (formal, quantitative) and epistemological (psychological, qualitative) – both of which are constantly misread and used interchangeably thus leading to many problems. "Statistical probability was the sole legitimate form of probability, the sole basis for knowledge. Consequently, »statistical probability« − and the associated world of »randomizing devices« − has become a metaphor for epistemological probability" [5]. The mathematical concept is what gave the idea of probability its content and epistemic aspect. Conversely, *epistemological* probability, secondary and derivative to the statistical one, is the result of preferred theoretical interpretation rather than correlations between actual events. In this sense, the formal (mathematical/statistical) aspects serves as the basis for presenting the target – the agent's imagination of probability as well as his/her experience of uncertainty (mental states). In other words, the abstract serves as a metaphor for the concrete.

Regardless of these ambiguities and reciprocal relations (recognizable at the theoretical level), people commonly conceive, and subsequently cope with, probability as a state of their own *beliefs* rather than events or affairs. It so

happens that statistical probability becomes a definition – a convincing metaphor of people's thoughts and actions – affecting the experience of the world and any knowledge one might claim to have about it. Such a metaphor serves the descriptive function of supplying explanation for unstable, unpredictable, unfamiliar cognitive phenomena such as making choices, predictions or decisions under conditions of uncertainty. Besides, to a certain extent, it also plays a rhetoric function of encouraging people to perform particular socio-cognitive acts with the expectation of securing some profits, especially in the context of randomized events and situations. But in either case metaphoric thinking obscures that which it actually aims to reveal and explain. That is why Raymond W. Gibbs recognizes a specific "»paradox of metaphor« in which metaphor is creative, novel, culturally sensitive, and allows us to transcend the mundane while also being rooted in pervasive patterns of bodily experience common to all people" [1]. It is not particularly rare for this simple figurative manner of thinking to change ways in which more complex phenomena such as the probability of events are conceived.

This seemingly contradictory nature of metaphoric thinking would mean that people engaged in the same are really unable to exceed their physically, mentally and culturally entrenched limits, their conceptual schemas. In transcending what is empirically evident (source domain) and consequently entering cognitively into new, more complex intellectual domains (target), agents are confronted with many empirical constrains – gestures, mental and linguistic schemas, and/or social customs and values. They conceptualize complex and abstract phenomena by means of material, practical devices and instruments, which is especially evident in the context of probability. This specific conceptual-instrumental equipment is of particular use when coping with randomness.

Empirical studies on the mentioned problems of probability and information [2] have lead to interesting conclusions which shed some light on the metaphoric confinement of communication and information. Gerd Gigerenzer holds that all types of decision-making, ranging from simple and intuitive to more complex and rational, are based on limited information. It means they all such choices are far from rational where agents would be equipped with complete and reliable knowledge. Indeed, situations of complete information – where an agent would be able to compute all available courses of action and thus make a fully informed choice – are unattainable. Considering possibilities and selecting probabilities is not algorithmic but mostly heuristic. People tend to make *correct choices* (when buying, investing or communicating) more easily and more often when they are faced with relatively few alternatives, otherwise they would be overwhelmed with the extent of analysis necessary during decision-making. This is a strategy which relies on gut feelings, the so called rule of thumb, in other words intuition. "The quality of intuition lies in the intelligence of the unconscious, the ability to know without thinking which rule to rely on in which situation" [2]. Intuition might give the agent a chance to use more discretional ways of expression, which he/she conceives as similar as well as more (or less) probable. In this way metaphoric thinking combines with intuition and helps us to understand complex situations.

The same correlation has been observed and empirically studied by Daniel Kahneman and Amos Tversky [9] in their theory of making decision under uncertainty. They hold that while making a decision or solving practical and cognitive problems, the agent utilizes relatively constant *cognitive biases* which reflect his/her specific, unavoidable cognitive faults and errors. They include intuitive judgements and beliefs which play a particular role in the assessment of random events and their probability. "[P]eople rely on a limited number of heuristic principles which reduce the complex tasks of assessing the probabilities and predicting values to simpler judgmental operations" [9]. In particular, biases such as: (1) not properly identifying representativeness in a sequence of events, (2) excessive ease in evaluating such sequences, and (3) incorrectly settling statistical problems based on an erroneous evaluation of input data, are decisive for the agent's cognitive faculties. There are also others that result from the agent's cognitive inability to conceive probabilities of events. Namely, the agent assumes erroneous representativeness relative to the transfer of qualities or probability from one class of events to another. It is due to his/her incessant *search for similarities* between facts and events, despite their evident dissimilarity. In conditions of such cognitively biased thinking, the agent becomes especially susceptive to any suggestive expressions that strengthen this tendency, which is when the role of metaphors becomes particularly crucial.

5 PRACTICAL CONSEQUENCES

It is worth mentioning that the problem of developing proper metaphoric concepts and models of information and communication, apart from the strictly methodological aspects of the same, has certain practical consequences. Shannon and Weaver did not consider these consequences to be relevant to only the explanatory aspect of metaphoric phrases they have themselves used on occasion. But if the conduit metaphor, implied in their conception, might confuse people, be it experts, theorists and laymen conceiving what information is and how it is communicated, the issue of the metaphoric confinement of the very concept of information acquires significance. It may influence the way people communicate and decisions while selecting and processing signals and information. Indeed, it may induce or even compel them to make wrong choices while sending and receiving various types of messages such as orders, inquiries, requests, the news, pictures, texts etc. Such instances occur in the context of education, public affairs, political domains or mass culture, wherein communication is fundamental. In these sociocultural domains – in their institutions and organizations such as schools, colleges, universities, libraries, cultural, scientific and research centers – metaphoric phrases, definitions and conceptions of information and knowledge are of particular importance. Only metaphors possessing dynamic and probabilistic, rather than static or linear connotations in their source domain can describe processes of knowledge acquisition and communication whose quantitative aspect is information. By appealing to astonishing phenomena, they can adequately anticipate new and unforeseen informational processes and events; their rhetorical impact would thus change the previous, conservative conceptualization. Only such enriched figurative thinking is able to evoke human *creativity* in cognitive, intellectual, social and cultural areas.

The cognitive, or more precisely descriptive role of informational metaphors is largely realised within the

discipline of information and knowledge organisation, which commonly employs the definition of information formulated by the mathematical theory of communication. As was already discussed in [3], metaphors pertaining to various data bases utilised by libraries, offices or governmental bodies, as well as any open (internet) repositories of knowledge, play a significant role in defining ways in which these can be organised and used. Rather than merely describe and model, they also provide opportunities for creation and administration, as well as, most importantly, effective utilisation of the same by various users. Many of the existing metaphors of knowledge organisation employ metaphorical descriptions, many dating back as far as antiquity or the middle ages, which compare accumulated and available knowledge to buildings (towers, libraries), labyrinths, vast open spaces (on land or sea), trees, maps, networks, or rootstalks. Each of the above emphasises the physical and spatial (geometric, linear and finite) characterisation of knowledge which is typically depicted as a complete and perfect source of information. Consequently, any attempts to acquire knowledge, expand it, discover new content, or establish new connections, will be described using metaphors such as juggling, wandering, exploring, leafing through, deciphering, enquiring, responding, etc. Such metaphors will normally emphasise a rather passive and unproblematic use of information gathered in static and invariable deposits and data bases. If such metaphors are to serve the function of directives or recommendations, rather than merely descriptions or models, they are likely to be addressed to persons involved in the creation and management of such resources, and not so much to regular users of knowledge systems. The latter have in recent decades been approached with ever more plentiful metaphorical expressions pertaining to the internet, which predominantly carry either clearly positive or negative cognitive and emotional connotations and relate to repositories of information and processes of researching for the same. If inclined positively, such metaphors employ phrases whose source domain includes such positively charged expressions as surfing, exploring, richness, surprise, enrichment, etc. Otherwise, information and the internet may likely be metaphorically described as junk, smog, excess, boundlessness, impoverishment, threat, etc.

All informational metaphors (regardless of their axiological associations) become significant only if used in such a way that, aside from their obvious function of describing (modelling) the existing knowledge and information resources, they also encourage their addressees to engage in a particular course of cognitive action. Shannon's conclusion that the gist of information refers not to what is, but to what *can be communicated*, constitutes an important methodological directive in constructing metaphorical references to knowledge and information. Namely, they should refer to the cognitive expectations of particular agents and the realistic possibility of their fulfilment, rather than merely ready-made realisations and factuality. To accomplish this, however, it is necessary to have a criterion allowing for a distinction between: (1) real (realised, own) cognitive *needs* of internet users and (2) apparent (imposed, unrealised) cognitive *demands* encountered when using software tools and applications. Such metaphorical expressions – suggestive but free of obtrusive marketing and advertising tricks – should take the form of directives and guidelines, commands and, most importantly, warnings addressed to internet users.

Any metaphors but particularly those functioning as suggestive linguistic expressions have (as dictated by their rhetorical and eristic origin) a considerably persuasive force which is manifested through inspiring specific behaviours. If an informational and communicational metaphor comprises in its source domain expressions and phrases relating to the expected, possible, and likely, rather than exclusively actual and unambiguous cognitive situations, it will be successful in performing its persuasive function. It can then become an instrument shaping the attitudes of the cognitively wealthy rather than just the informatively impoverished. Moreover, a properly structured metaphor of knowledge organisation will facilitate internet users in making decisions and tackling cognitive problems, wherein access to suitable information is the necessary condition of success. By indicating possibilities and likelihoods – hidden behind apparent information, unavailable to software users overly preoccupied with the operation of these instruments – such a metaphor may reveal the full informative value of a cognitive situation and allow its due recognition.

6 CONCLUSION

It has been shown that metaphoric phrases used by Claude Shannon and Warren Weaver in their Mathematical Theory of Communication are only complementary, and not main in describing what information is. Owing to the theory of conceptual metaphor, one can recognize the implicit mental structures underlying such way of conceptualizing. It has also been suggested that informational metaphors might constitute useful instruments in coping with probable states while making decisions.

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