

Exploring the Information Carrier

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Abstract: *This article discusses three issues related to information carrier. (1) "Bare information" does not exist, which has nothing to do with the carriers; the evolution of information is inseparable from the evolution of information carrier. The evolution of this symbol code developed from non-coded information to coded information and from the material code to the natural language is the result of natural self-organization. (2) The emergence of words means starting other-organization evolution of information carrier, and the new information carrier can only be a human conscious creation. The main direction throughout the evolutionary history of information carrier is: the more the operation of information depends on material energy reduce, the more the efficiency of information operation improves. (3) The information carrier has different levels, caused by different strength of material carriers. The division of carrier level also means the division of information level, that is, the difference of information levels can be attributed to differences between the carrier levels. The carrier with strong materiality can load the carrier with weak materiality, not vice versa.*

Keywords: Information; Bare information; information carrier; symbol

So far, Academic research has very little information related to the information carrier. In this case, Wei-Guo Yang has proposed the comment: "whether we can grasp of the information starting by exploring the relationship between carriers or not" [1], this is very valuable. Various objective information activities called information operation (or information assignment), including the collection, indication, recording, encoding, decoding, transmission, processing, proliferation, innovation, storage, extraction, transcription, translation, conformity, using, elimination, etc., of information. Each of them is carried out for the information carrier, collecting information is collecting the information carrier, transmitting information is transmitting the information carrier, and processing information is processing the information carrier, and so on. Neither does "bare information" exist, nor does "bare information operations" that has nothing to do with the carrier's. This defines the importance of inspecting information carrier.

1. The evolution of information and information carrier

The material world in the general trend is evolving, from simple to complex, from low to high evolution. As the important attribute of material moving, the information moving also has experienced from simple to complex, from low to high, from entirely dependent on material to relatively independent of material. The evolution of information moving can not apart from the evolution of the information carrier, in some extent, information evolution and information carrier evolution are the same thing, the evolution of information should be expressed by evolution of the carrier, human can understand the evolution of information only according to the evolution of the carrier.

In the physics level and chemistry level, information moving totally is the attachment of the energy moving and substances moving, the different material systems load itself information on each other through direct interaction. The interacted matter is mutual interaction source and mutual information

carrier, and mutual information resident (information resident can be viewed as special information carrier; the information carrier also can be viewed as specific). In this level of the material world, A rolling in B cause the changes that the information of A is been recorded by B, on the other hand, A and B can change their roles. That is, A and B made the information exchange, information operations is just so. There is no encoding indication to information, information processing, and transcription, and so on. That is to say, there is no encoded information and based-encoded communication but only non-encoded information. So the material moving belongs to the lowest state of information moving.

An important direction of Information and information carrier evolution is that the source and the carrier of information should been departed. If B record the information of A, but this cause a litter change on A, we regard A as source and only regard B as information carrier. The possibility of completing the separation between the information source and the information carrier in the evolution exists in the objective world itself. Two Objects are mutual information carrier, the ability of change each other general is asymmetric, it is impossible in principle that the directly interacted objects are not been completely changed by others, but the degree and way of be changed is different in principle, the efficacy as other' information carrier is also different, sometimes the difference is great. As the interacted both sides, if A cause more changes on B than B to A, B carry more information of A and A carry less information of B, this situation is a normality. This kind of asymmetry is exactly the objective foundation of separating information and information source, information source and carrier. The evolution of the universe needs to produce a kind of material form, its function mainly or even totally role in information carrier. Separation of information and information source, information source and carrier produce the material form specializing in expressing, recording and carrying information. There is the "full-time" information carrier, allowing information source and information resident to exchange information indirectly through the constellation (the

information carrier), this avoid colliding directly and improve the level and efficiency of information operation greatly. This kind of situation is the most ideal: A changes B but is not changed by B at all, source A and carrier B totally separates, that is, the carrier carry the information of the information source but does not influent the information source at all.

The birth of life is the first major leap during the evolution history of nature, creating a special kind of information carrier DNA. The DNA carries a kind of encoded information; its appearance means that the nature maybe products a system first. It has the ability to encoding and expressing its self micro information by accurately and orderly way and record on the carrier DNA, and replicating DNA makes life information created and accumulated in natural evolution is preserved, then the information system can be replicated. The sperm-eggs combination forms the carrier DNA which carries with offspring genetic information which will not do harm with parents' body, so it is the ideal information carrier. The information operations of inanimate world conduct based on non-encoded information, but the animate world conduct based on encoded information, this may be the basic difference between animate and in inanimate. From the non-encoded information to the encoded information, this has very important significance in the evolution.

The information code expressing and encoding information is classified material code (non- symbolic code) and symbolic code. A, T, C, G, which are the four nucleotides constituting the DNA, are material form, so DNA essentially is still material entity code but not the symbolic code. DNA's appearance is far not the end of evolutionary information carrier. But, a large number of different DNA totally distinguish by the turn of A, T, C, G, that indicate the four nucleotide also have certain symbol function. DNA also has certain characteristics of the symbolic code; maybe we can call it as the quasi-symbolic code. This information code can products life, and carry life information, but it can not be enough to produce and carry with nervous information. Biological information still attached to the material entity totally.

A significant step evolution in nature information and information is the nerve system which can transform matter moving information in external world into information carried by nerve signals which is nerve information, eventually evolved brain nerve system. The appearance of neural information source and carrier represents that separation of information source and information resident reach to a new level. Animals accept and carry information of external world through the nerve system without changing the external world, but they can process this information. Animals' brain, especially human brain as the highest form, is a unique physical form evolved by nature. Its only function is information operations (including all possible forms of information operations). Brain nerve system can engage in all kinds of information operations because of the follow reason : The brain is a kind of special material form information, its also is a kind of unique information carrier, only in the material form brain nerve system can produce, indicate, record, process, store and eliminate consciousness (mind) which is the highest form of information, can emerged with relative independence for material moving of consciousness moving, and can conduct the most complicated and colorful information operations. So it is necessary to study the brain as information carrier and ignoring this research is a defect of brain research now.

As a special information carrier, brain nerve system is a kind of complex nonlinear dynamic network. Its information operations depends on the state of physiological moving within the brain or certain encoding expression of consciousness information by nerve signals, and then engage in all kinds of information. This letter is a kind of material code but not symbolic code, however it possible has the natural ability of transforming into symbolic code (this is different from DNA) making the consciousness within brain externalized. We still know little about the magical point of external information. The brain can only accept, transmit, process and store the information carried by nerve signals, this is its magical point and also cause serious constraints to the information operation within the brain, especially the restriction to the communication and information processing.

Brain nerve network as the carrier of information, the biggest shortcoming is the vulnerability that it is easily damaged and could not exchange information with other things through direct interaction so that it have to be closed up by hard skull, regarding nerve system as intermediary to exchange information with the outside world. Only if the outside information is transformed into the nerve information, it can be transmitted into brain becoming the consciousness operation, the consciousness information within brain is transmitted to sensory through the nervous system, but it is very difficult to be accepted by external matters (information resident). When does the consciousness activity, brain must be sent to the electromagnetic wave outside which is cannot be received by other brain in principle because it is very weak and carry very little consciousness information. the natural Information moving evolutes to this step own to two sides: on the one hand, the highest form of consciousness information appears, which produces the conscious requirements of exchanging information with other individual; On the other hand, the consciousness activity was closed in the individual skull so that it is very difficult to communicate with each other individual, this constitutes a pair of sharp contradictions. The only way to solve this contradiction is to create a special kind of information carrier that it is a kind of special material form outside the human brain and consciousness information can use it to be encoded and expressed and carried outside brain nerve system, and it can make consciousness externalized, also can be perceived (visual, audible, touchable), can receive and explain and read for other individuals to mutually communicate information. This is the symbol carrier.

Originally created is semi-symbol that body language use human body organs to encoding and expressing consciousness information, including facial expression, meaningful glance, body movements, a simple tweet, etc.. The higher animals have own this ability. Consciousness information relying on body language to encoding and expressing is extremely limited and difficult to regulate, but energy consume very large, the efficiency of operation information is low. So it is far from the effective way of solving the

above contradiction. Fortunately, the evolution of human brain and vocal organs and auditory organs offers an alternative solution. Nature evolve to such step, as said "these people in forming have reached the step that they must speak when they has something", human nature language as the carrier of information finally is "produced in labor together with labor "[2].

Causing air to vibrate with its own organs to encode and express consciousness information, computer systems as a source dose not need a direct physical effect with the outside world; this means the greatly improved of the performance information carrier. Human natural language is a symbolic carrier of high performance and high efficiency, since then there is the strict sense of the information processing, storage and communication. However, this is also the final step of evolution of natural information carrier.

2. Artificial symbol carrier

Natural language is not the final step of the evolution of information carrier, followed by the step is producing artificial symbolic carrier. Only using this symbol recording, transmitting, processing, storage information can make the information source and information carrier separated maximize, thus provide the most effective means to the operation of various kinds of information, especially information processing.

Awareness information within brain must be externalized through symbol carrier, only explanting from the interpersonal communicating information (communication) is not enough. The key is information processing in varies information operations within brain, only through this information operation information may be proliferated and innovated; this is the deepest mechanism of human evolution. Information operation depending on natural language as symbolic carrier is mainly based on auditory information; human body organ, which can take part in the thinking operation after awareness messages externalized, mainly is the speech organ and the auditory organ. The visual information that human brain can obtain, process and use is far more than auditory information, but it is difficult for the human body to express, send

and store the visual information depending on the body language (expressing and sending the visual information through meaningful glance, facial expression, gesture etc. is too limited). Because it could not give the systematic encoding and expression to visual information, then this greatly limits the breadth and depth of the brain information operation, especially the information processing (that is thinking). In the early human thinking activity, the visual organ is secondary, while the hand-organ basically exposure outside thinking activities. Such thinking activities have hardly any practical character so that level and efficiency of thinking is extremely low, the key is the lack of a kind of symbol vector to make visual information externalization and play the role of hand.

Overcoming this limitation and leading to another major advance of information carrier is the symbolic encoding expression of visual information, created by the artificial language which is information carrier. The key here is siphoning all information what can be able to express with form (status, body, shape, image etc.) from the material world, making the concept of form abstracted and preparing the symbolic expression way of matter's shape, the information of status, body, shape, image, spatial distribution and spatial relationships about the external matters recorded and transmitted to brain by the neural signals use the artificial symbols to express. The initial creation may be the rock paintings, and the mature product is the words of all nationalities. The emergence of words makes various information operations of the human brain enhance quality. Take the example of thinking moving: as eyes, ears, mouth, hand participate in the meantime, the thinking within brain is said out with mouth (language practice), expressed and recorded by words and other symbols (writing and drawing practice), transformed into information operations outside brain; the information dealt by language words translated into nerve information through the eyes, ears, etc.; then feedback to the brain, re-stimulate thinking moving; and take part in the externalization once again through the eyes, ears, mouth, and hands; do processing, amend, supplement and enhance again, forming this cycle of non-linear movement including brain

thinking, mouth and hand encoding expression, eye and ear feedbacking information. This gives a distinctive practical character of thinking activity character, greatly improved the breadth, depth and efficiency of thinking.

Artificial symbol has the following characteristics as an information carrier. First, in addition to the information contained band (including the beautiful-sense information carried by the symbolic form, such as calligraphy), it has no any other function of material entity; Second, it loose all the material property which have nothing to do with information operations, even the quality what is the most basic material property also become meaningless, but for retaining some material entity perceived (visual, audible, touchable). People never care the quality of symbols when engage in the information operations. The material property of information carrier is retained less, the efficiency of information operation is higher, and the form of carrier is senior. Third, use artificial symbols to make consciousness information tie on the carrier outside human body. this is belongs to the information loading way of changing the least with carrier, indicate that the separation of information source and the carrier is further than the sound language, and information operations efficiency is higher. Because of these features, the symbol carriers have the special function of encoding and expressing the abstract or image information in the brain to get the highest efficiency of information operation. Without the help of human brain, nature could not evolve so efficient information operations.

So-called artificial symbol language as words and so on is more effective than the sound language and body language; this view cannot be absolute Comprehend. The ability of using language, especially using word to expressing consciousness information, is limited. And the tone and intonation etc. of the spoken language can express consciousness information, but the word can not encode. There are many information consciousnesses that can be sensed but unspeakable even encoded expression by word. Therefore, the older spoken words: when speech word is not enough to express feelings and achieve intended, people can sing songs about it,

dances about it by hands and feet. This is an important manifestation of the humanities information complexity.

From the non-encoded message to the encoded message, from presenting DNA to presenting the brain nerve system, from the material code to this kind of character code that human creates natural language; the evolution of information carrier is the result of self organization. But the emergence of words means starting other-organization evolution of information carrier, the new information carrier can only be a human conscious creation. Its core is various artificial languages creation, like mathematical language (symbol), musical language symbol), engineer design language (symbol), until computer language 0, 1 string. The main direction throughout the evolutionary history of information carrier is that, the more the operation of information depends on material energy reduce, the more the efficiency of information operation improves. The dependence of sound language on material is less than that of the body language, and that of the artificial symbol is the least than former, but the corresponding efficiency of information operation actually greatly enhances. Looked at the carrier of quantity information, the most junior of keeping records by tying knots (rope is entity carrier, knot is the symbol, ties a knot is information encoding), it takes the material entity as the symbol; The Arabic numeral is the most advanced, except 1, other digit is abstract symbol without any image ingredient; Comparatively, Chinese numeric symbol retains more material property, its counting efficiency is also lower. Looked at each natural language, the material property of the alphabetic word as information carrier is less, it is more advantageous to processing this kind information of abstract thinking; The Chinese character retained the massive image material attribute, it is more advantageous to processing this kind information of image thinking. Both each has its advantage.

However, as long as it is the information carrier, more or less retain certain material properties. Needless to say material carrier, as a senior information carrier of symbols, such as voice, text, numbers, etc., is still material things, it needs some material

substance or material wave status, which can be expressed and fixed in order to contain and transmit information. Sensual words depends on the changes of vocal organs and body, text or numbers requires a colored pigment to smear, broadcast or carved in the physical carrier, all belong to some material form. The most weak dependence on material information carriers is computer language like 0, 1 symbol string, artificial symbols evolved to this point, the material properties of carrier seems to have been reduced to the extreme, it is likely to create less material than the symbol, and a major evolution of information carrier maybe stop here, or need to open up a new direction that we can not predict.

3. The level of information carriers

Wei-Guo Yang also put forward a unequal's view that a information can be the carrier of another one [3]. This author has some reservations, however Young's proposition must exists misunderstanding of the information and the carrier, actually also contains the reasonable essence , It raises the issue of information carrier's levels which is the Young's so-called information's levels problem.

There are all kinds of information carriers, some carriers require other carriers and can be carried with others. Paper, tape, text, and voice, are information carriers, but the text can be fixed on paper, voice can be fixed to the tape, when a carrier carry another carrier, the former has carried the information the latter carries, instead that one kind of information load another kind of information. Paper and tape is entirely material, text and voice is although the symbolic carrier, but they also retain the visual material which can view and listen, showing the difference between the carrier's levels. On brain systems, the physical moving is the basis of physiological moving, physiological moving is the basis of psychological moving, physical signal carries with physiological (nervous) signal, physiological (nervous) signal carries with psychological signal, the level of information carrier is also very clear. Obviously, the level of information carrier is divided according to the amount of strength of the material properties, and the stronger carries the

weaker, the more carries the less, and otherwise it is impossible.

Into the field of consciousness (thinking, psychology) activities, the problem of levels becomes complicated. Usually when talking about consciousness or mind or mental activity, we only regard them as informational activities, without considering their dependence on the carrier. This causes much confusion about cognitions. In relation to problems of consciousness, thinking, psychology, especially must stress that there is no bare information in the world, as long as mentioned information, it always involve in some carriers that have the material properties, always the multi-material information carry with the less-material information carrier. Division of carrier's levels simultaneously means that of information levels, information levels' difference can be attributed to the difference of carrier's levels; both in real terms are same thing. Story's plot, themes, and literary grace, are all the information, The teacher require students to outline its subject after read the story, because the story's plot can regard as information carrier of subject, literary talent, author style and so on. But the story's plot can play a role in carrier' function, in compared with the theme, plot's dependence on material is stronger, and it is closer by the material world. In the final analysis, it carries the theme information with the help of material. Scientific theory knowledge carries the information of philosophy thinking, poetry carry with the information verve and poetic realm, etc., they are also the truth. Chinese Literary Theory is particular about the distinction between the word meaning and implicated meaning, since they are meaning, whether word meaning or implicated meaning, all belong to the information rather than material; But they are different on substance dependence, word meaning has a direct link with text symbols, and it is nearer to the material world, so it can act as the carrier of implicated meaning. Directly reading those texts to grasp the word meaning, then we can understand some implicated meaning through carefully tasting the word meaning [4]. In the final analysis, the so-called implicated meaning is still hidden in the carrier of words meaning.

In the brain's consciousness activities or mind activity, subconscious information carrier is the physiological movement status (neural signals) of nerve system, it belongs to the non-encoded information; conscious mind information mainly can use symbolic carrier to encode and express the carried information. Therefore, the thinking process is the process of using language words to encode and express subconscious information transforming it into the conscious mind information. Sometimes, we realize that there is a thought or idea in our brain, even thoughts like waves, but we feel that we could not think clearly and tell out. This situation means the subconscious information has accumulated enough to reach the critical point of transforming into conscious mind, but only subconscious information use language words to encode and express, it can complete the transformation to the conscious mind information. The subconscious information can not encode and express, the information, which only can be sensed but unspeakable in conscious mind, also is non-encode information. That is, Lao Zi so-called "the principium which couldn't be talked out; the thing which couldn't be described". They know that the principium cannot be told out but want to tell out, know that the thing cannot be described but want to describe, this indicates they were not subconscious any more, but should be conscious mind in essence. We can see, information is constituted by two parts: one part is the information which can use language word to encode and express, the other part is the information which sublimate from subconscious information, and can feel by self but cannot encode and express information. Chinese people often say that words cannot completely express meaning, or words are finite while meaning is infinite. So-called "words cannot completely express meaning" is some things that is transforming into conscious mind (can be sensed) but not yet able to encode and express using language word (be unspeakable). The so-called "words are finite while meaning is infinite" means conscious mind information which can use language word to encode and express is limited. However, The consciousness information which only can be understood but told out make people feel that

the subconscious information have no edge and unfathomable, so there is "brain sea".

Chinese traditional culture has a deep understanding of the levels of information and information carrier. Roughly speaking, literature, especially the information of poetries involved, mainly have two types: one is emotion information, the other is environment information. Literary and poetics advocate that find emotion's sustenance in environment senses; on the contrary it is not advocated. This involved in the asymmetry of level relationship. Sustenance is equal with loading information. Speak the words of Wei-Guo Yang, emotion information can be loaded on environment information, otherwise is not admitted. The reason is that environment information is closer than emotion information from the physical practice process.

Today, go back to see the way of Shannon's information measurement, its wise point is to avoid the measurement of physical quantities including quality, momentum and energy etc., but it is to consider the number of symbols used in encoding and the randomness of chosen symbol, obtain the indirect measurement to information by directly measuring the carrier. As long as the material property of carrier reduce to the level of symbol and make the encoding and expression standardize, the measurement to the number of using symbols carries, in a considerable degree, stand for the measurement to information. The quality what is a kind of physical properties is unmeaning to the symbols used to encode and express information. However, the number of symbols used in encoding expression and the related property is meaningful, needs to be measured. The same standardized symbols can express consciousness information which can be talked out, as long as there is no redundancy, the more symbols used, the more information carried. It's still some material measurement to measuring the number of used symbols and the related property, which is complete different from the measurement of the traditional concept.

Since there is no bare information, we should not expect to measure the information only through measuring vector and brushing aside material. Therefore, if semantic

information and pragmatic information can be measured, it should be the material property of carrier measured, but compared with grammatical information, they would certainly be more innovative and unique, more subtle. Shannon's information measuring method has obvious limitations, it contains a corollary: encoding symbols are used less; information also will be carried less. If applied to semantic information, which means you can claim: information of a five word poem must be less

than that of a seven word poem; a United Nations document translated from Chinese into English will increase the information, because the Chinese text is poor than the English text. This is of course absurd. So we once again return to this argument: Do not confuse the information with the information carrier, after all, the measurement to information carrier is not the same as the measurement to information.

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