

What We Know/Need to Know About Information in Plants and Animals



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Abstract

Information is a fundamental component of the biological structures, which drive both the body structuration and behavior of plants and animals. The specific information of each species in genome/genes is transmitted from Deoxyribonucleic Acid (DNA) molecules to the new cells and to proteins by replication and transcription/translation processes respectively, to build/maintain the body structure. Information play also a dynamic role in the internal and external communication, assuring the adaptation to the external cues, according to the specificity of each category of plants and animals, on the entire biological evolutionary/complexity scale, operating on the basis of an informational system, with the same functional characteristics. Therefore, the question of consciousness, as effect of the activity of the informational system in plants and animals is discussed, as a natural emerging issue.

Keywords: Information; Living structures; Cognitive/sentience/decisional capabilities; Informational system of plants and animals; Consciousness/pseudo-consciousness

Introduction

Since thousands of years ago, the human seeks for a solution to the question what is life and what is consciousness, and philosophy, neuroscience and biology still try to give a response comprehensive to such questions [1], but no significant progresses were up to date registered, without introduce and refer to the essential contribution/intervention of information in the living structures [2-5]. Information is not only a concept operating within our communication systems, which allow to connect each other and with the surrounding world. We have to know that information is deeply involved in our body structuration and abilities, although this is not easily to admit, if we don't look attentively the intimate mechanisms involved in the information processes. Information animate and give sense to our life. Therefore, in this paper are shortly presented the mechanisms of the informational processes which support life on the entire evolutionary/organization scale of the biostructures, showing the essential role of information not only for their behavior, but also in their structuration as living organisms. On this basis, is discussed the question of consciousness in plants and animals, derived/initiated especially with respect to plants, non-endowed with a nervous system, evoking pro [6,7] and contra [8,9] arguments.

Body Structuration/Maintenance is Based on Informational Processes

The millenary belief on the living, even persistent in nowadays, is that body and mind are two distinct categories, because body is regarded as a material-consistent mechanical/inert-like structure, while mind is something different, with actually not specified/known consistence. The solid-state physics and the science and technology of information show that the solid bodies, in particular the semiconductor materials, are not at all simple mechanical structures, their micro-structural organization allowed the development of our informational/microprocessors devices which we enjoy today in our informational era [10,11]. Based mainly on electronic-type conduction, carried out/supported by the negatively/positively charged

electron/holes in silicon, the informational devices which we use in our daily activities are electronic informational processors, while informational processes in living organisms are based rather on chemical transport of information, stored mainly in carbon-type memory, the Deoxyribonucleic Acid (DNA) structure [12].

The genes/genome contain all necessary information for the structuration of a new organism by means of the replication process, and by transcription/translation of information to form proteins, the elemental material components which build actually the body. We can define therefore the Genetic Transmission System (GTS) and Info-Genetic Generator (IGG). These two informational systems allow the multiplication and development of the body, with specific complexity, depending on the organization/evolution complexity scale, from unicellular organisms to the most complex one, animals or plants [13,14]. Information is transmitted from DNA in a four "letter-alphabet" of the nucleotides by various messages consisting in DNA sequences from the gigantic molecule of DNA, copied by the Ribonucleic Acid (RNA), combined with amino acids (20 different types in human), which contribute with additional informational elements for protein formation. Proteins are not only the basic structural components of the body, but also operate as informational agents, allowing the communication between various parts of the eukaryotic/prokaryotic cells of (plants/animals)/bacteria organisms respectively, transporting the necessary information from origin to the target places/organs/organelles [12,14].

The semitransparent membrane play an essential selective role in reception/transmission of information, by pores and surface receptors, specialized to receive only certain type of information/chemical agents. In multicellular organisms, the communication is mainly transmitted by hormones and electrical impulses through the nervous system in animals. The metabolic processes connect plants and animals to the energy source and material substituting micro-elements necessary to body maintenance/(re)construction, mainly supported by mitochondria organelle in eukaryotic cells of plants/animals and translation processes (IGG). In plants, the chloroplast-a distinct organelle, fabricates glucose by a chlorophyll light-assisted process for energetic needs processed further in mitochondria. Golgi's apparatus distributes micro-elements in animals/plants cells, as a 'hearth'-like system. A Maintenance Informational System (MIS) is operative therefore at any level of the living organisms, together with GTS and IGG forming the Programmed Informational System (PIS) of any organism. Although without an evident electrical transmission system like animals, but provided with Ca²⁺ and other conduction channels [15], plants are also active informational organisms, assuring the internal/external communication by direct cell-cell and hormonal transmission [14].

Plants and Animals are Knowledge-Endowed/Decisional Living Systems

The living organisms are able to detect the external conditions and to react/adapt accordingly, so they are endowed with an informational system, managing their body [16]. The adaptation

process is based on a sensory network for info-detection, connected to the memory as a reference for analysis and decision, so a Center of Acquiring and Storing of Information (CASI) and a Center of Decision and Command (CDC) of Execution Elements (EE) can be defined, which form together with the Info-Reactive Sentience System (IRSS) the Operational Informational System (OIS) for adaptation [12]. The Info-Connection (IC) center allows the selection of the necessary information, serving only each species or cell in the multicellular organisms, according to their specific tasks and functions. Therefore, an Informational System of The Human Body and Living Structures (ISHBLS) can be defined as following:

$$\text{ISHBLS} = (\text{CASI} + \text{CDC} + \text{IRSS}) + (\text{MIS} + \text{GTS} + \text{IGG} + \text{IC}) = \text{OIS} + \text{PIS} \quad (1)$$

Animals dispose of a nervous system as a sensitive tool for connection with the environment, which determine the opinion that these are endowed with knowledge/decision making capabilities, so with consciousness [17]. Plants, these silent/non-moving organisms accompanying our life with modesty, non-endowed with a nervous system, which is considered to be an imprescriptible operational tool, are not included in this category. However, the experimental evidences contradict this opinion, unfortunately derived from an insufficient knowledge of how information is operational also in these structures. Although more slowly, but really efficient, plants are connected to the reality of the surrounding environment and react accordingly, adapting their functioning to the external conditions. To distinguish, but in the same time to acknowledge the existence of an Informational System of Plant Cells and Plants (ISPCP), we will define it as following:

$$\text{ISPCP} = [(\text{CASI} + \text{CDC} + \text{IRSS}) + (\text{MIS} + \text{GTS} + \text{IGG} + \text{IC})] \text{Plants} \quad (2)$$

In terms of information/ISPCP, CASI is revealed in plants by their capabilities to detect and react to humidity/humidity gradients, light/light intensity, temperature/temperature gradients (affecting the plant tropism and their capacity to memorize and to choice between variant alternative (IC/IRSS/CDC) [18], plasticity, germination, flowering, and shape development, based on the light modulation of auxin signaling between the organs and root [19], vertical growth, shade tolerance and lateral-avoidance [20], gravity/electromagnetic fields and by their network of mechano-perception sensors for the perception of numerous mechanical signals, referred to gravitropic, thigmomorph, thigmotropic, self-loading, growth strains, turgor pressure, xylem pressure potential, and mechanical vibrations of sound [21].

Plants show slow behavior, but not always: Venus flytrap for instance is a carnivore plant, like other similar 600 species, endowed with a rapid motor response (CDC/EE), appropriate to catch/hold/devour/digest animals (MIS) [22]. Plants use chemical components as communicating channels with insects and animals for pollination (GTS), or as defense against the predators (IRSS/CDC), electrical signals and vibrations [23]. Plants are sentient organisms [24] (IRSS), which can live in symbiotic association [25-27], acknowledging their family membership. Indeed, the root apex transition zone, able to make timely decisions and solve

problems concerning the optimal orientation as a function of the local topology [28], is often compared with 'like-brain' decisional center; working also as a lung-like respiration system, as a 'heart'-like pumping/distributer of water and nutrients, and maintainer of the physiological balance and hormonal info-communication (by means of auxin like 'neurotransmitter' and plasmodesmata like neuro-gap-junctions), throughout the entire plant [29]. The organs of the terrestrial plants are organized according to their local importance, reversely like in animals, but really working: their "head" is fixed in their soil, and their "neck" (stem), sexual organs (flowers, seeds) and metabolic system (leaves) rise in air.

Plants and animals are endowed therefore with their own individual knowledge/decision making/sentient OIS system, which can modulate their PIS for development/maintenance/adaptation to the local conditions, at which they are connected by their endowment IC "window". Among the diversity of informational signals which interfere with them from the surrounding ambient, each specie is connected to reality through a limited informational "window", which allow to "see"/"feel" the convenient segment, according to the specie experience and development in the local (terrestrial, water, air) conditions, and to adapt accordingly. The adaptation is a learning process, based on epigenetic mechanisms for acquisition of new traits, inter-generationally transmitted (GTS/IGG) [30], which imposes/determines the further development on the evolutionary scale.

In human, consciousness is a result of the activities of the components of the informational system, detected/operating as cognitive centers [31]. Information perceived from the external panorama is integrated by thalamus, and is reflected unitarily and interpreted according to the mental "dictionary"/language [32,33]. In cell, the external information is detected by the surface receptors, but the diversity of the cell response is given rather by the combination between signals, than the high number of signaling molecules [29], so in the cell, the integration process of information is operative also on the detection/decisional/sentient pathways, according to the cell biologic patterns. Moreover, the principles of functioning of the biological structures are the same on the entire scale, as revealed by the ISHBLS/ISPCP, so the question if animals/plants structures could possess consciousness is naturally emerging.

However, the question of consciousness as operating in human, cannot be transposed automatically in plants and animals, neither as the same meaning nor as consistency is concerned, because each of them explores and interprets reality in its specific fashion, although similarities can be of course evoked between closer species of the same animals or plant kingdom, like between mammals for instance. The comparison between the knowledge/decisional/sentience abilities in animals and plants cannot be conclusive, and any way not detrimental to plants, even these are not endowed with a nervous system: indeed, following this line, if we compare the behavior of carnivore plants with the "intelligence" level of inferior animals, this would be favorable to plants, because they are able to capture and digest them.

However, the unified concept of information and informational system, operating in seven registers in all the living structures, from prokaryotic/eukaryotic unicellular to more complex multicellular organisms, allows us to admit the existence of a certain degree of consciousness, which rudimentary, but operational efficiency, as much as necessary for each species to live its own life, which can be defined as pseudo-consciousness, with a basic corresponding level defined as proto-consciousness in unicellular/cells organisms. This is equivalent to admit that in own reference system of connection/interpretation of reality, according to the informational tools which dispose of each species, and to necessities of detection through own narrow window of observation of reality, each individual interprets the external panorama of cues and "plays" the game of own life, based on own tools and decisional capabilities. In this sense, no organisms, no matter how simple or small be on the ranking scale, cannot be excluded from the living categories with even elemental/rudimentary consciousness/pseudo-consciousness, because this is a property of life itself.

Conclusion

The living organisms are informational systems living their life, which operate by means of PIS for body structuration/maintenance/transmission of genetic information, explores each of them reality by connection to IC "windows", interprets this reality and adapts each of them to the local environment conditions by OIS. The structural composition of the informational system of the human body and living structures, the same for all organisms, from unicellular to more complex multicellular organisms, endowed or not with a nervous system, shows the unitary organization of the biologic organisms, supporting consciousness as an informational effect of the informational operability of the body.

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