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Let's leave the prejudices: Plants are informational systems, living their life

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ABSTRACT

Plants, like all other living organisms, are neither robots and nor artificial smart systems, they are living structures, which live their life. Plants are informational living organisms, endowed with an informational system, like all other living structures. Although they do not dispose of a nervous system like animals, they carry out an intense informational activity of communication with their internal structure between various parts of it and with the surrounding environment. They are able to make decisions and to regulate their phenotype, showing that they dispose of a cognitive/sentient system driving their behaviour and structural development, according to the local conditions.

Keywords: Plants, Living structures, Information, Embodiment/Disembodiment of information, Cognitive/Sentience/Decision making, Informational system/Model of plant cell and plants.

INTRODUCTION

The question if plants are really endowed with capabilities to decide their fate within the limits of their local conditions, especially in comparison with animals, and even with humans, is still a discussible question (Rivera-Serrano, 2021), and on this issue can be evoked pro (Raja et al, 2020) (Debono, 2013) (Segundo-Ortin and Calvo, 2021) (Hiernaux, 2021) and contra arguments (Mallatt, 2021) (Taiz et al, 2019). As the main difference between plants and animals is the lack of a nervous system in plants, advantageous in animals and human because it permits to drive the mobility of their body, to detect the characteristics of their environment, to decide in consequence their fate, or to intervene to change it as a function of the momentary conditions, plants seems to be not endowed with their own driving info-detection and decision-making utilities, so their presence within the scenery of own living world would be rather decorative than active. In this paper, it is reported and described an informational system of plant cell and plants, as a basis for further discussion of the informational behaviour of plants and their active role in their own life, approaching also the question of "consciousness" of plants and the controversial debates on this matter.

INFORMATIONAL MODEL OF PLANTS

Informational system of the plant cell and plants

As it was recently reported, information in the living organisms is an essential component, supporting their functions and effectively intervening in their intimate internal processes (Gaiseanu, 2021) (Gaiseanu, 2020). Although information is a concept largely used nowadays in our communications and mass-media devices, with an increasing consumption measured in GBits, we have to understand that the role of information in

the living organisms is fundamental for their operability (Gaiseanu, 2019) (Gaiseanu, 2021). Perhaps surprising to many of us, information is not only an essential components of living world, but of non-living materials, besides matter and energy (Gaiseanu, 2021). The introduction of information and understanding its role in the functioning of organisms by "embodiment"/"disembodiment" of information during the structuration/destructuration processes (Gaiseanu, 2019) (Gaiseanu, 2020), allowed to understand the relation between mind and body, a millenary unsolved problem by philosophy and neither by our modern neuro or bio-sciences (Gaiseanu, 2021), the nature/nurture (inheritance/training) dilemma in psychology (Gaiseanu, 2019), the info-assisted evolution of the brain (Gaiseanu, 2020), the multi-task neuro-rehabilitation in geriatric therapies (Gaiseanu, 2020), to name only a few of them. The examination of the functions of the eukaryotic cell as the basic living unit of animal and plants, in comparison with the functions in the human organism (Gaiseanu, 2020), allowed to reveals that the basic components of their informational systems are similar, so that an Informational System of the Living Structures (ISLS) can be defined. The main difference of the plant cells in comparison to the animal eukaryotic cells is the additional chloroplast organelle involved in metabolic system of plants, for preparation of glucose by the solar light-assisted process of photosynthesis, described as (Carbon Dioxide+Water → Glucose+Oxygen), in many ways opposite to respiration, according to the reaction (Oxygen+Glucose → Water+Carbon Dioxide and Energy). An Informational System of the Plant Cell and Plants (ISPCP) can be therefore defined:

ISPCP=(CASI+CDC+IRSS)+(MIS+GTS+IGG+IC)= OIS+PIS (1)

where CASI is the Centre of Acquisition and Storing of Information, with activity based on the sensorial/memory network of the cell, CDC is the Centre of Decision and Command, based on the activity of the decisional/command network of the cell, IRSS is the Info-Reactive Sentience System, equivalent with the info-emotional system in human, MIS is the Informational Maintenance System, driving the metabolic processes, GTS is the Genetic Transmission System, IGG is the inherited Info-Genetic Generator, and IC is the Info-Connection system, administrating the specific distinctive information of species or of the unicellular organisms, among the huge quantity disposable around, according only to their specific tasks. PIS (Programmed Informational System) manages the fundamental functions of metabolism and genetic inheritance/transmission, whereas OIS (Operative Informational System) intervenes for operative adaptation to the environment. The epigenetic processes integrate information in the genetic system adding new traits, but conserving the characteristics of the species (Gaiseanu, 2020).

This mechanism explains/shows the fundamental role of information in the dynamic adaptation to the environmental cues. Plants are connected thus to matter/energy and information, all of them contributing to the existence/survival of their structure and adaptation. The activities of OIS modulate PIS like in an informational device (Gaiseanu, 2021), and the epigenetic processes allow the transmission/embodiment of acquired information toward (=>) the genetic system by structuration mechanisms, trans-generationally (==>) translated (OIS=>PIS==>IGG to the new generation).

Plants live their life as cognitive/decisional-sentience structures

Plants, these silent creatures, without an obvious expressiveness, although this does exist, with slower behaviour, but evident in a larger time-scale, are cognitive-sentient living structures, covering more than twenty different sensorial capacities (Mancuso and Viola, 2015). The experimental evidences strongly support the ISPCP model. Indeed, the activity of CASI is revealed by their sensitivity to detect humidity/humidity gradients, light/light intensity, gravity and electromagnetic fields, volatile chemical components, used as a communicating channel with insects and animals to attract them for pollination (GTS), or as defence against the predators (danger sentience/decision – (IRSS/CDC), electrical signals and vibrations. Plant defend themselves against the herbivores or pathogens by a sophisticated signalling network, within the entire organism (CASI/IRSS), elicited/driven by herbivore-induced factors and plant signalling (phytohormone and volatiles), leading to a rapid response (CDC) (Arimura, Ozawa, and Maffei, 2011). The long-distance communication process between plants was demonstrated experimentally, showing that the wounded leaves signalize their damage status (IRSS/CASI), which stimulates the production of jasmonates, potent regulators of defence responses (Mousavi et al, 2013).

Plants are sentient organisms (Calvo, Pratap and Trewavas, 2017) (IRSS), can live in symbiotic association (Oldroyd, 2013), and behave differentially with respect to the surrounding partners from family provenience (IGG) through their sentient-cognitive system (CASI/IRSS), expressed by the root selectivity (IC/CDC) for allocation of resources (Dudley and File, 2007) (Dudley and File, 2008).

Mimosa pudica closes suddenly its leaves by its executing elements (EE) connected to CDC, in response to the touch (CASI). Touch is a basic sense of at least 600 species of carnivore plants (like Venus flytrap for instance), endowed with a rapid motor response (CDC/EE), appropriate to catch/hold/devour/digest animals (MIS) (Suda, 2020).

The defence against predators can show selective

(IC)/decisional operability (CDC), and is manifested by the release of a toxic compound, only in leafs attacked by insects, showing danger sentience and decision making (IRSS/CDC) capabilites (Mancuso and Viola, 2018) (Mousavi et al, 2013). Actually, the network of mechanoperception sensors (CASI) is highly developed for the perception of numerous mechanical signals, referred to gravitropic, thigmomorphic, thigmotropic, self-loading, growth strains, turgor pressure, xylem pressure potential, and mechanical vibrations of sound (Telewski, 2006).

Roots are able to monitor their route (CASI/CDC), as a function of the surrounding topography, even with anticipation (IC), for catching/intake of the food resources (MIS). The activity of the roots is considered actually similar with that of a brain in animals (Baluška et al, 2004) (Calvo and Keijzer , 2011), because these are able to make timely decisions and solve problems concerning the optimal orientation, but not only: these act also as a "hearth", pumping nutrients toward entire plant structure, transmit executive commands of plasticity to the body, work as a long-distance respiration system, besides stem and leaves (energo-laboratory), and maintain the physiological balance and hormonal info-communication of plants, by auxin and plasmodesmata 'neurotransmitter'-like in neuro-gap-junctions (Alberts et al, 2015).

Actually, the plant architecture seems to be reversely organizedlike that of animals, according to the importance and functions of each organ: their "head" is fixed in their soil and their "neck" (stem), sexual organs (flowers, seeds) and metabolic system (leaves) rise in air The plant tropism and their capacity to memorize (CASI) and to choice between variant alternative (IC/IRSS/CDC) (Nick and Schäifer , 1988), referring to vertical growth, shade tolerance and lateral-avoidance, (Gruntman et al, 2017), even by association with other previous events (Gagliano et al, 2014) (Gagliano et al,2016), were demonstrated to be relevant cognitivecapacities of plants, especially to cover their metabolic demands (Gagliano et al, 2016). This isa valuable premise to understand that the learning by association is a universal adaptive mechanism shared by all organisms (Gaiseanu, 2019) (Gagliano etal, 2016). With a metabolic system (MIS) depending on the sun light, plants dispose of sophisticated light receptors and sensing networks to detect the light intensity/orientation/duration, spectral quality and localization. They respond by a decisional (CDC) "attitude"/behaviour as a function of circumstances, concerning their plasticity, germination, flowering, and shape development, based on the light modulation of auxin signalling that elicit local/long distance signalling between the organs and root (Halliday, Martínez-Garcıía, and Josse 2009).

Plants are nottherefore robots, they do not apply automatically foreign orders, and they are able to lead themselves their life, according to the surrounding conditions, like all other living creatures, each of them involved/living their own scenario (Gaiseanu, 2021) (Harari, 2016), and using their own detection/interpretation tools (Harari, 2016)(Gaiseanu, 2022). It is naturally therefore to admit that plants, as well as all other living structuresnot only dispose, but must to dispose of a cognitive/sentient system, which can modulate the adequate adjustments required for adaptation to circumstances. This is actually the admirable capacity of the living organisms, as a general/fundamental feature, which distinguishes them from non-living or artificial intelligent structures. The common general informational structure revealed by the ISLS/ISPCPS models, experimentally confirmed, constitutes afundamental base to treat the living systems with the same unit of measure, despite of their high diversity of conformation/body structure and behaviour. The level of consciousness, in the sense in which we understand it in humans, cannot be transposed directly to other living organisms. The comparison of the conscious connection of lower- ranking animals with that of plants is also difficult to admit (Taiz et al, 2019). If we would follow such a line, we could believe that the carnivorous plants, although without a nervous system, are smarter than some lower-ranking animals, since they can acquire their prey with really surprising skilled tools. The question is thus, how they were able to "observe" the environment so well, to "understand"/realize how they would proceed, and how they "invented/created/built" such an efficient hunting tools.

Evolution itself is a great motif/challenge for contemplation on the info- creation power and the degree of a conscious reaction of the living structures, even we consider it as "pseudo-consciousness'', anyway different from the human's. The evolution is an extremely slow process, but the slower it is, the more efficient it is, determined by a motivated/intentional/self-organization, with an info-assisted relevant result, transmitted inter-generationally by epigenetic/genetic (IGG/GTS) mechanisms.

We can refer therefore to a certain level of knowledge/sentience/"pseudo-consciousness", operative in the living structures, applied successfully by their operational/decisional system for adaptation/resolution of their concrete living problems, valid even for the smallest unit of life–cell, that which works independently or as integrated in a multicellular organism, fulfilling 'carefully' its own role. The attempt to define awareness and consciousness, even to compare it with a theoretical minimal consciousness, invoking for instance the integrated information theory, itself under debate (Mørch, 2019), is likelydestined to be the subject of endless polemic debate (Raja et al, 2020) (Debono, 2013) (Segundo-Ortin and Calvo, 2021) (Hiernaux, 2021) (Mallatt, 2021) (Taiz et al, 2019), as long as we don't dispose of the necessary non-subjective means to quantify them.

However, we dispose now of the informational model of the living structures, showing the common informational structure of all creatures, from unicellular to multicellular organisms. According to this model, the living organisms are structured corresponding to the same typical info-organizational scheme, comprising a main component–(PIS), dedicated to the body maintenance/reproduction/restructuration, and another one–(OIS), necessary for the sentience/vigilance/surveillance of the environment and body itself, for decision making and transmission of adequate decisional commands to the development/growth structuration systems. The living organisms/plants live their life, with their sensitivity and their problems to be solved, even if they seems to be low for us, but vital/difficult and really high for themselves, in their living world. OIS actually modulates PIS to meet external requirements, like an informational device. The living organisms are able to modulate both their body structure and their functioning in relation to their living environment, based on their operability in the seven informational registers, defined by ISLS/ISPCPS, differently in each species, and different also from any other artificial system.
Therefore, distinctly of other definitions of consciousness/pseudo-consciousness or proto-consciousness in plants or other living organisms, and in accord with the common structure/functionality of the informational system of the living structures on the entire evolutionary/organization scale, it can be defined a rudimentary, but operative cognitive system, expressing a certain level of knowledge/pseudo-consciousness/consciousness in any living structure, strictly related to the characteristics of their informational system, so with various degrees of development and reactivity, according to the particular endowment sensorial/cognition tools and interpretation of surrounding reality in their ecosystems, from an incipient proto-consciousness level of unicellular organisms, to human consciousness, as commonly is this interpreted in this case.

CONCLUSION

Plants are "vivant" organisms, living their life, as all other living organisms, each of them according to their local ecological conditions, which make the difference between them, but all of them on the basis of a typical common structure of the informational system, composed by seven informational components, revealed by the Informational System of the Plant Cell and Plants (ISPCPS), strongly supported by the experimental evidences. These findings show the power of information, which is deeply involved in the structuration/functionality of the living structures, allowing defining a specific level of consciousness/pseudo-consciousness for every living organism, depending on the complexity of their development and local conditions, from a proto-consciousness of the unicellular organisms, to consciousness of human, as it is commonly interpreted in this case.

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